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CLUTCHING

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SPECIAL TOOLS AND SUPPLIES

TOOL DESCRIPTION	PART NUMBER
Clutch Alignment Tool (Non-EBS)	**PA-49011**
Clutch Bushing Replacement Tool Kit	**2871025**
Clutch Bushing Replacement Tool Kit	**2871226**
Clutch Holding Fixture	**2871358-A**
Clutch Holding Wrench	**9314177**
Drive Clutch Puller	**2870506**
Drive Clutch Spider Removal and Installation Tool	**2870341**
Piston Pin Puller	**2870386**
Roller Pin Tool	**2870910**
Universal Clutch Compressor	**PU-50518**

SPX Corp: 1-800-328-6657 or http://polaris.spx.com/

SPECIAL SUPPLIES	PART NUMBER
Loctite™ 609	**N/A**
RTV Silicone Sealer	**8560054**

TORQUE SPECIFICATIONS

PVT System Fastener Torques

ITEM	TORQUE VALUE
Drive Clutch Retaining Bolt	47 ft. lbs. (64 Nm)
Driven Clutch Retaining Bolt	17 ft. lbs. (23 Nm)
PVT Inner Cover Phillips-Head Screws	50 in. lbs. (5.6 Nm)
PVT Inner Cover Hex-Head Screws	12 ft. lbs. (16 Nm)
PVT Outer Cover Bolts	45-50 in. lbs (5-5.6 Nm)
Drive Clutch Spider	200 ft. lbs. (271 Nm)
Drive Clutch Cover Plate	90 in. lbs. (10 Nm)

HIGH ALTITUDE CLUTCH CHARTS

All Models (Except 2012 *RANGER* HD)

Altitude		Shift Weight	Drive Spring	Driven Spring
Meters (Feet)	**0-1500 (0-5000)**	23-62 (5632337)	Black (7043594)	Blk / Almd (7043167)
	1500-3700 (5000 - 12000)	23-58 (B) (1322911)	Black (7043594)	Blk / Almd (7043167)

2012 *RANGER* HD (EBS)

Altitude		Shift Weight	Drive Spring	Driven Spring
Meters (Feet)	**0-1500 (0-5000)**	23-62 (5632337)	Black (7043594)	Red (3234452)
	1500-3700 (5000 - 12000)	23-58 (B) (1322911)	Black (7043594)	Red (3234452)

PVT SYSTEM OVERVIEW

General Operation

⚠ WARNING

All PVT maintenance or repairs should be performed by a certified Polaris Master Service Dealer (MSD) technician who has received the proper training and understands the procedures outlined in this manual. **Because of the critical nature and precision balance incorporated into the PVT components, it is absolutely essential that no disassembly or repair be made without factory authorized special tools and service procedures.**

The Polaris Variable Transmission (PVT) consists of three major assemblies:

1) The Drive Clutch

2) The Driven Clutch

3) The Drive Belt

The internal components of the drive clutch and driven clutch control engagement (initial vehicle movement), clutch upshift and backshift. During vehicle development, the PVT system is matched first to the engine power curve; then to average riding conditions and the vehicle's intended usage. Therefore, modifications or variations of components at random are never recommended. Proper clutch setup and careful inspection of existing components must be the primary objective when troubleshooting and tuning.

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Drive Clutch Operation

Drive clutches primarily sense engine RPM. The two major components which control its shifting function are the shift weights and the coil spring. Whenever engine RPM is increased, centrifugal force is created, causing the shift weights to push against rollers on the moveable sheave, which is held open by coil spring preload. When this force becomes higher than the preload in the spring, the outer sheave moves inward and contacts the drive belt. This motion pinches the drive belt between the spinning sheaves and causes it to rotate, which in turn rotates the driven clutch.

At lower RPM, the drive belt rotates low in the drive clutch sheaves. As engine RPM increases, centrifugal force causes the drive belt to be forced upward on drive clutch sheaves.

Driven Clutch Operation

Driven clutches primarily sense torque, opening and closing according to the forces applied to it from the drive belt and the transmission input shaft. If the torque resistance at the transmission input shaft is greater than the load from the drive belt, the drive belt is kept at the outer diameter of the driven clutch sheaves.

As engine RPM and horsepower increase, the load from the drive belt increases, resulting in the belt rotating up toward the outer diameter of the drive clutch sheaves and downward into the sheaves of the driven clutch. This action, which increases the driven clutch speed, is called upshifting.

Should the throttle setting remain the same, and the vehicle is subjected to a heavier load, the drive belt rotates back up toward the outer diameter of the driven clutch and downward into the sheaves of the drive clutch. This action, which decreases the driven clutch speed, is called backshifting.

In situations where loads vary (such as uphill and downhill), and throttle settings are constant, the drive and driven clutches are continually shifting to maintain optimum engine RPM. At full throttle a perfectly matched PVT system should hold engine RPM at the peak of the power curve. This RPM should be maintained during clutch upshift and backshift. In this respect, the PVT system is similar to a power governor. Rather than vary throttle position, as a conventional governor does, the PVT system changes engine load requirements by either upshifting or backshifting.

PVT Break-In (Drive Belt / Clutches)

A proper break-in of the clutches and drive belt will ensure a longer life and better performance. Break in the clutches and drive belt by operating at slower speeds during the 10 hour break-in period as recommended (see Chapter 3 “Engine Break-In Period” for break-in example). Pull only light loads. Avoid aggressive acceleration and high speed operation during the break-in period.

Maintenance / Inspection

Under normal use the PVT system will provide years of trouble free operation. Periodic inspection and maintenance is required to keep the system operating at peak performance. The following list of items should be inspected and maintained to ensure maximum performance and service life of PVT components. Refer to the troubleshooting checklist at the end of this chapter for more information.

1. **Belt Inspection, Drive to Driven Clutch Alignment, and Clutch Center Distance.**
2. **Drive and Driven Clutch Buttons and Bushings, Drive Clutch Shift Weights and Pins, Drive Clutch Spider Rollers and Roller Pins, Drive and Driven Clutch Springs.**
3. **Sheave Faces.** Clean and inspect for wear.
4. **PVT System Sealing.** Refer to appropriate illustrations on the following pages. The PVT system is air cooled by fins on the drive clutch stationary sheave. The fins create a low pressure area in the crankcase casting, drawing air into the system through an intake duct. The opening for this intake duct is located at a high point on the vehicle (location varies by model). The intake duct draws fresh air through a vented cover. All connecting air ducts (as well as the inner and outer covers) must be properly sealed to ensure clean air is being used for cooling the PVT system and also to prevent water and other contaminants from entering the PVT area. This is especially critical on units subjected to frequent water forging.

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Overheating / Diagnosis

During routine maintenance, or whenever PVT system overheating is evident, it's important to check the inlet *and* outlet ducting for obstructions. Obstructions to air flow through the ducts will significantly increase PVT system operating temperatures. The vehicle should be operated in Low when plowing or pulling heavy loads, or if extended low speed operation is anticipated.

CLUTCH DRIVE BELT & COVER RELATED ISSUES: DIAGNOSIS	
Possible Causes	**Solutions / What to do**
Loading the vehicle into a truck or tall trailer when in high range.	Shift transmission to Low during loading of the vehicle to prevent belt burning.
Starting out going up a steep incline from a stopped position.	When starting out on an incline, shift the transmission to Low.
Driving at low RPM or low ground speed (at approximately 3-7 MPH).	Drive at higher speed or use Low. The use of Low is highly recommended for cooler PVT operating temperatures and longer component life.
Insufficient engine warm-up when exposed to low ambient temperatures.	Warm engine at least 5 min., then with transmission in neutral, advance throttle to approx. 1/8 throttle in short bursts, 5 to 7 times. The belt will become more flexible and prevent belt burning.
Slow and easy clutch engagement.	Fast, effective use of the throttle for efficient engagement.
Towing/Pushing at low RPM/low ground speed.	Use Low only.
Plowing snow, dirt, etc./utility use.	Use Low only.
Stuck in mud or snow.	Shift the transmission to Low, carefully use fast, aggressive throttle application to engage clutch. **WARNING:** Excessive throttle may cause loss of control and vehicle overturn.
Climbing over large objects from a stopped position.	Shift the transmission to Low, carefully use fast, aggressive, brief throttle application to engage clutch. **WARNING:** Excessive throttle may cause loss of control and vehicle overturn.
Belt slippage from water or snow ingestion into the PVT system.	Shift the transmission to neutral. Using the throttle, vary the engine rpm from idle to full throttle. Repeat several times as required. During this procedure, the throttle should not be held at the full position for more than 10 seconds. Clutch seals should be inspected for damage if repeated leaking occurs.
Clutch malfunction.	For inspection of clutch components, please contact your Polaris dealer. Shift transmission to Low during loading of the vehicle to prevent belt burning.
Poor engine performance.	Fouled plugs, foreign material in gas tank, fuel lines, or carburetor. Contact you dealer for further service information.
GENERAL RANGE OPERATION GUIDELINES:	Low: Heavy pulling, basic operational speeds less than 7 MPH, riding through rough terrain (swamps, mountains, ect.), low ground speeds.
	High: High ground speeds, speeds above 7 MPH.

Operating in Low Gear

Low gear is the primary driving gear range for *RANGER*s. Low should be used in ALL driving applications except for driving on hard packed level surfaces with light loads. In this circumstance, High range may be used.

IMPORTANT: Using High range for heavy loads, hilly terrain, or in wet, muddy conditions will increase the chance of drive belt burning.

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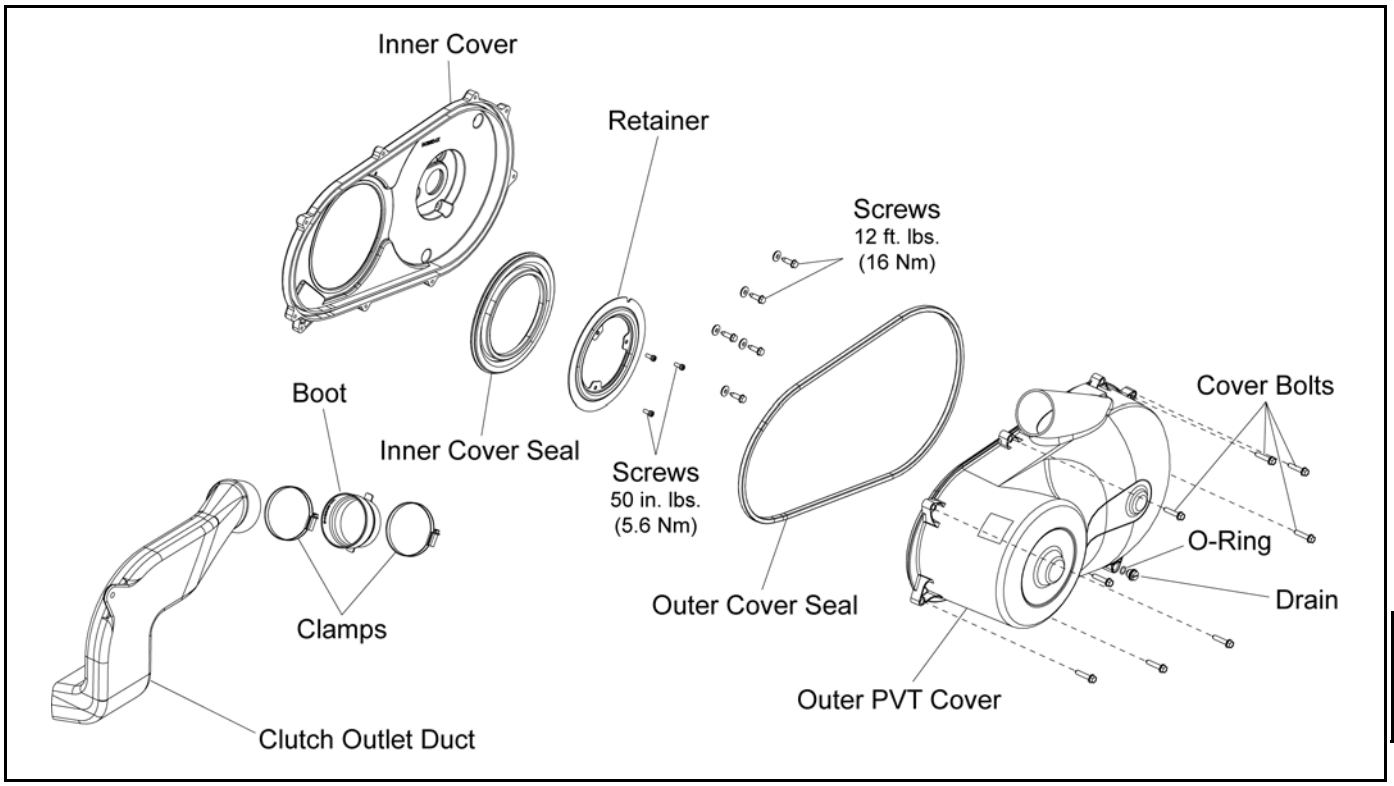
PVT SYSTEM SERVICE

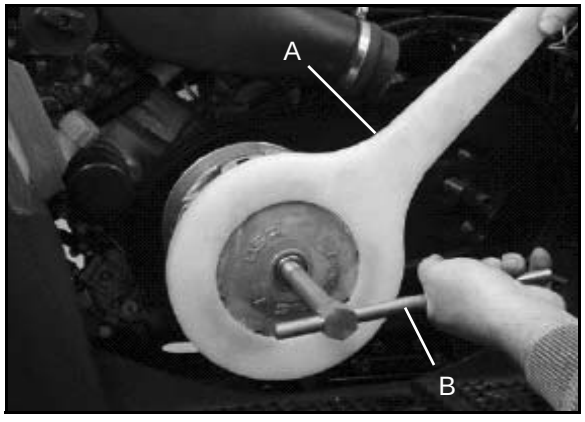
PVT Sealing, Guard, and Ducting Components



Disassembly

Some fasteners and procedures will vary. Refer to the appropriate parts manual for proper fasteners and fastener placement.

1. Remove seat and storage container to gain access to the PVT outer cover.
2. Remove PVT air outlet duct hose.
3. Remove outer PVT cover screws.
4. Mark the drive belt direction of rotation and remove drive belt. See “Drive Belt Removal”.

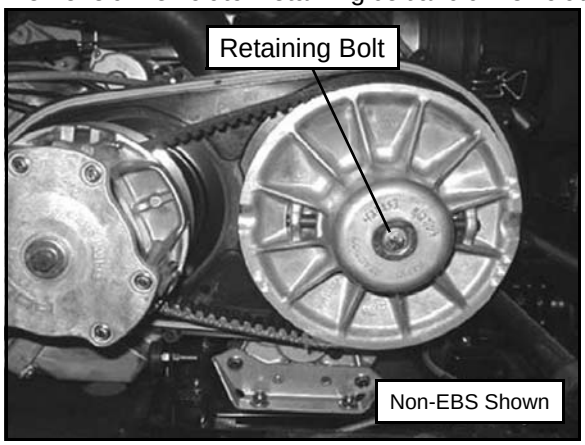


5. Install the Drive Clutch Holder (PN 9314177) (A).
6. Remove drive clutch retaining bolt and remove drive clutch using the Drive Clutch Puller (PN 2870506) (B).

Drive Clutch Puller (PN 2870506)

Drive Clutch Holder (PN 9314177)

7. Remove driven clutch retaining bolt and driven clutch.



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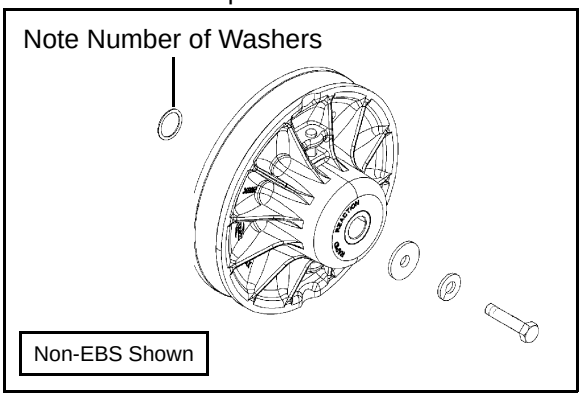
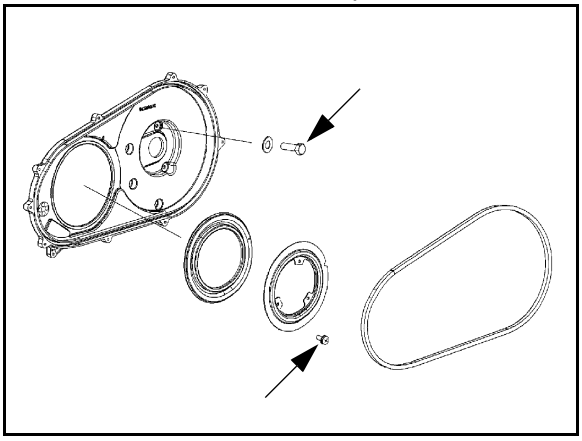
8. Remove the driven clutch alignment washer(s) from the transmission input shaft.



9. Remove screws and retainer plate.

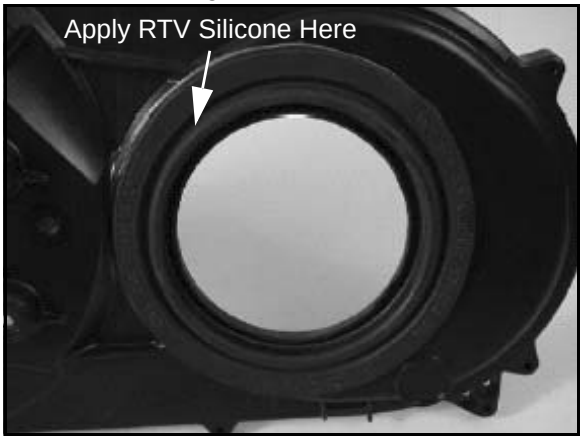


10. Remove inner cover retaining bolts at rear of cover.

11. Remove cover along with foam seal on back of cover or shaft.

Assembly

1. Inspect PVT inner cover-to engine seal. Replace if cracked or damaged.

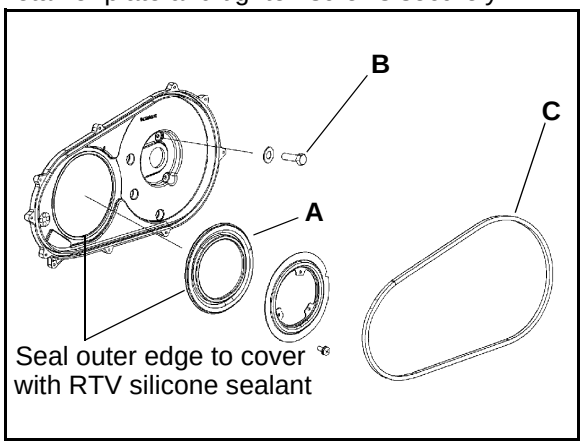


2. Place a new foam seal on transmission input shaft.

3. Apply RTV silicone sealant to outside edge of inner cover-to-engine seal, to ensure a water tight fit between the seal and the cover. Surfaces must be clean to ensure adhesion.

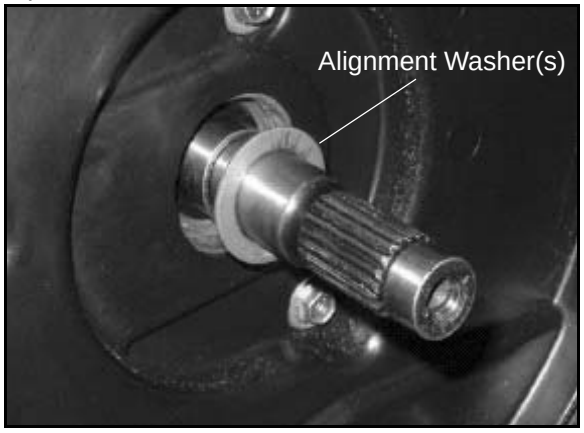
4. Reinstall cover and tighten rear cover bolts just enough to hold it in place.

5. Fit lip of inner cover seal (A) to engine. Install seal retainer plate and tighten screws securely.



6. Torque rear inner cover bolts (B) to specification.

7. Install clutch alignment washer(s) on transmission input shaft.



8. Clean splines inside driven clutch and on the transmission input shaft.

9. Apply a light film of grease to the splines on the shaft.

10. Install the driven clutch, washer, lock washer, and retaining bolt. Torque to specification.

11. Clean end of taper on crankshaft and the taper bore inside drive clutch.

12. Install drive clutch and torque retaining bolt to specification.

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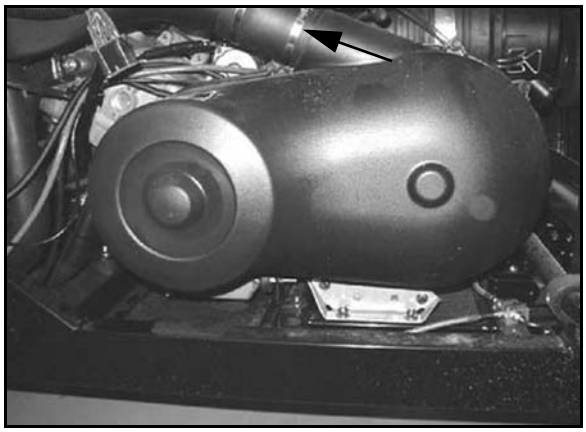
13. Reinstall drive belt noting direction of rotation. If a new belt is installed, install so numbers can be easily read.

14. Replace PVT outer clutch cover rubber gasket.

15. Reinstall PVT outer clutch cover and secure with screws. Torque screws to specification.

16. Install the PVT cover outlet duct and tighten the clamps.



Inner Cover Screw Torque:
Front Screws: 50 in. lbs. (5.6 Nm)
Rear Screws: 12 ft. lbs. (16 Nm)

Outer Cover Screw Torque:
45-50 in. lbs. (5-5.6 Nm)

Driven Clutch Retaining Bolt Torque:
17 ft. lbs. (23.5 Nm)

Drive Clutch Retaining Bolt Torque:
47 ft. lbs. (64 Nm)

DRIVE BELT (NON-EBS)

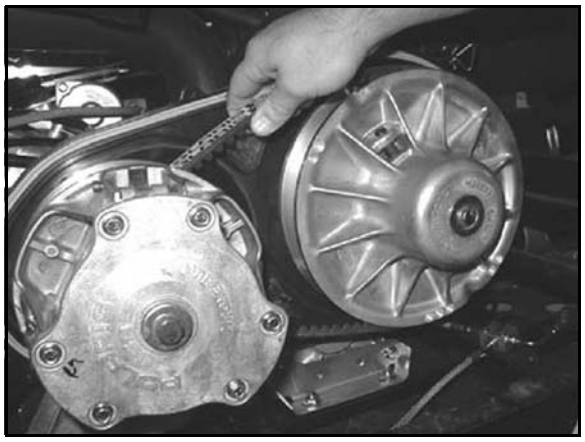
Belt Removal

1. Remove outer PVT cover as described in “PVT SYSTEM SERVICE - Disassembly”.

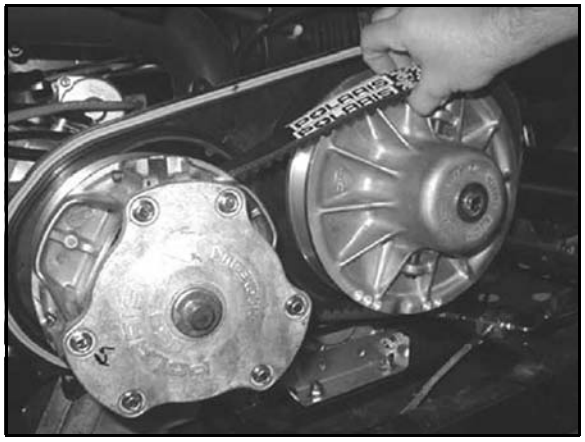
2. Mark the drive belt direction of rotation so that it can be installed in the same direction.

NOTE: Belt is normally positioned so that part numbers are easily read.

3. To remove drive belt, put transmission in gear, apply brake, pull upward and rearward on belt to open driven clutch sheaves.



4. Pull out and down on the drive belt to slip over the driven clutch outer sheave.



5. Slip belt over the drive clutch outer sheave and remove the belt from the vehicle.

Belt Inspection

1. Inspect belt for hour glassing (extreme circular wear in at least one spot and on both sides of the belt). Hour glassing occurs when the drive train does not move and the drive clutch engages the belt.

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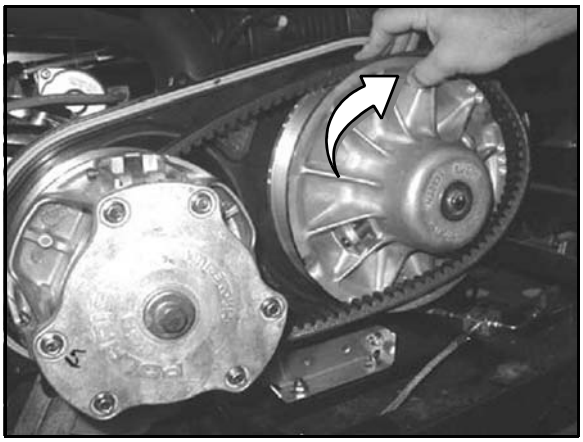
2. Inspect belt for loose cords, missing cogs, cracks, abrasions, thin spots, or excessive wear. Compare belt measurements with a new drive belt. Replace if necessary.
3. Belts with thin spots, burn marks, etc., should be replaced to eliminate noise, vibration, or erratic PVT operation. See the troubleshooting chart at the end of this chapter for possible causes.

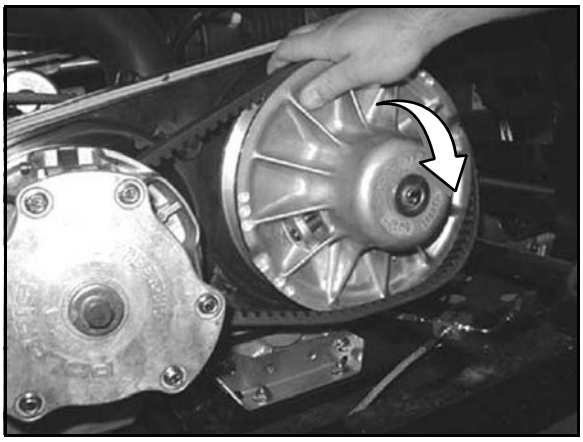
Belt Installation

NOTE: Be sure to install belt in the same direction as it was removed.

1. Loop belt over drive clutch and over driven sheave.



2. While pushing down on top of belt, turn the back or moveable driven sheave clockwise.



3. The belt then should be able to be pushed down into and between the sheaves.
4. Install the outer clutch cover and (8) screws. Torque screws to specification.

= T
Outer Clutch Cover Retaining Screws: **45-50 in. lbs. (5.5 Nm)**

DRIVE BELT (EBS)

Belt Removal

1. Remove outer PVT cover as described in “PVT SYSTEM SERVICE - Disassembly”.
2. Mark the drive belt direction of rotation so that it can be installed in the same direction.

NOTE: Belt is normally positioned so that part numbers are easily read.

3. Insert the belt removal tool (PN 2877408) into the driven clutch as shown (tool included with vehicle’s tool kit).

NOTE: Make sure the tool is square with the moveable sheave surface of the driven clutch.

4. Rotate the tool towards the clutch to open the sheaves.

5. Walk the belt out of the driven clutch and drive clutch. Remove the belt from the vehicle.

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Belt Inspection

1. Inspect belt for hour glassing (extreme circular wear in at least one spot and on both sides of the belt). Hour glassing occurs when the drive train does not move and the drive clutch engages the belt.

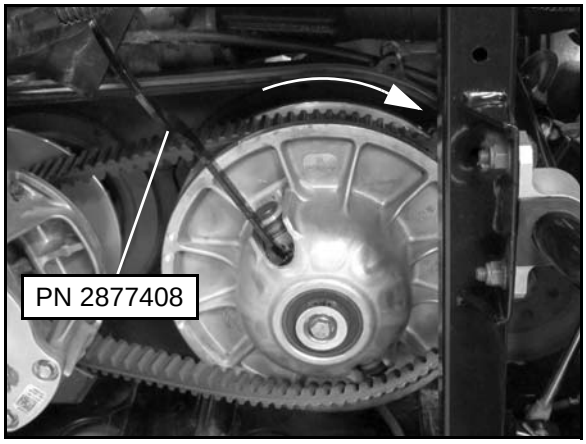
2. Inspect belt for loose cords, missing cogs, cracks, abrasions, thin spots, or excessive wear. Compare belt measurements with a new drive belt. Replace if necessary.

3. Belts with thin spots, burn marks, etc., should be replaced to eliminate noise, vibration, or erratic PVT operation. See the troubleshooting chart at the end of this chapter for possible causes.

Belt Installation

NOTE: Be sure to install belt in the same direction as it was removed.

1. With the belt removal tool installed (PN 2877408), loop the belt over the drive clutch and over the driven clutch.



2. Rotate the driven clutch and walk the belt into the clutch.

3. Remove the belt removal tool from driven clutch

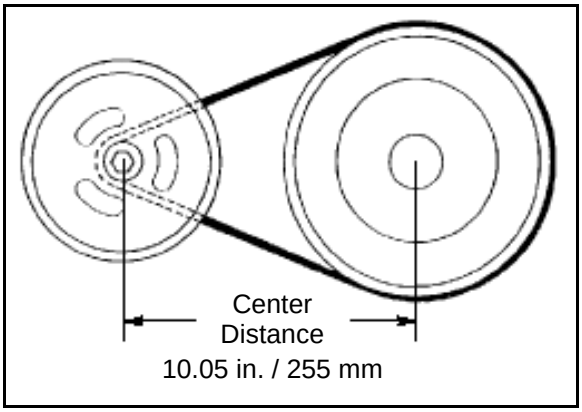
4. Rotate / spin the driven clutch and belt approximately 5-7 times to properly seat the belt in the driven clutch.

5. Install the outer clutch cover and (8) screws. Torque screws to specification.

= T
Outer Clutch Cover Retaining Screws: **45-50 in. lbs. (5.5 Nm)**

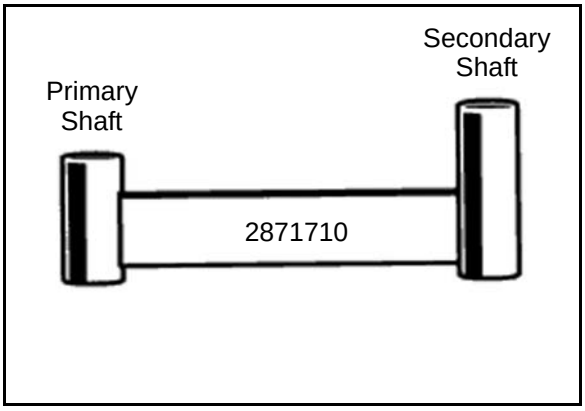
CLUTCH CENTER DISTANCE

Setting Center-To-Center Distance



Clutch center distance is controlled by the correct positioning of the engine and transmission mounting. The 10” Center Distance Tool (PN 2871710) should be used for the following:

- After engine installation.
- After transmission installation.
- After engine or transmission mount replacement.
- If the vehicle exhibits drive clutch drag or hard shifting while at idle speed, after clutch offset adjustment has been performed.



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CLUTCH OFFSET (NON-EBS)

Clutch Offset Procedure / Alignment Tool

Clutch offset is controlled by the number of washers that are placed behind the driven clutch on the transmission input shaft. Adding washers behind the driven clutch will move the drive belt toward the moveable sheave. Removing washers will move the belt toward the stationary sheave.

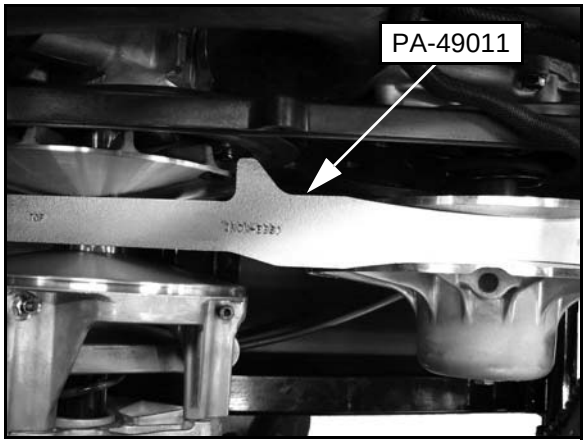
If the vehicle exhibits drive clutch drag or hard shifting while at idle speed, a clutch offset adjustment is required.

1. Remove the lower seat base.
2. Remove the LH storage container to gain access to the outer PVT cover.
3. Loosen the hose clamps and remove the PVT air outlet duct hose from the outer PVT cover.
4. Remove all outer PVT cover screws and cover.
5. Mark the drive belt direction of rotation and remove it. Refer to “DRIVE BELT (NON-EBS) - Belt Removal”.
6. Install the Clutch Alignment Tool.

CLUTCH ALIGNMENT TOOL

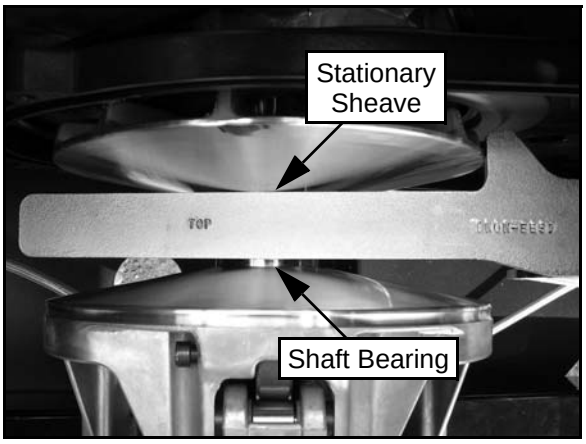
PA-49011

7. Place the alignment tool in the sheaves of the driven clutch and hold firmly as you rotate it down between the sheaves of the drive clutch.



Clutch Alignment Tool
PA-49011

8. As you rotate the tool down between the drive clutch sheaves, the tool should touch the clutch shaft bearing while maintaining a clearance of roughly .020” between the tool and stationary sheave of the drive clutch.



9. If the alignment tool hits the stationary sheave before it reaches the shaft bearing, the driven clutch will need to be spaced out to correct the offset.

   - Remove the driven clutch. Add the required amount of offset washers to obtain the correct measurement with the alignment tool. You may need to add more than one offset washer.

Offset Washers:
(.030”) PN: 7556454
(.060”) PN: 7556120

10. If the alignment tool touches the shaft bearing but has an excessive amount of clearance between the tool and stationary sheave, the driven clutch will need to be moved in to correct the offset.

    - Remove the driven clutch. Remove the required amount of washers to obtain roughly .020” clearance between the tool and stationary sheave.

NOTE: The number of washers behind the driven clutch will vary between vehicles.

IMPORTANT: It may not be possible to achieve perfect offset with the tool as previously described, because of the thickness of the offset washers. It is better to have clearance between the tool and stationary sheave of the drive clutch than to have the tool touch the stationary sheave before it touches the shaft bearing.

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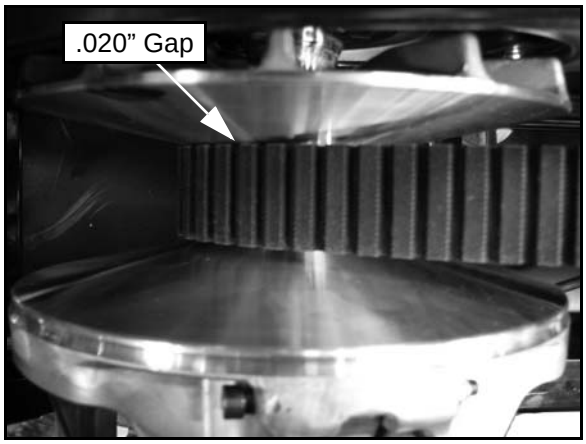
11. After completing the clutch offset procedure, the belt should ride in the drive clutch with an approximate .020” gap between the belt and stationary sheave and a larger gap of approximately .130” between the belt and moveable sheave. There should always be clearance on both sides of the drive belt.



CAUTION

Do not start the engine with the outer clutch cover removed. Serious injury may result.

12. Inspect the outer clutch cover gasket. Replace if damaged.

13. Install the outer clutch cover and (8) screws. Torque screws to specification.

= T

Outer Clutch Cover Retaining Screws:
45-50 in. lbs. (5.5 Nm)

14. Position the PVT air outlet duct hose and tighten the hose clamps.

15. Install the LH storage container and lower seat base.

16. Sit in the driver’s seat, apply the brake and start the engine. Place the gear selector in high range and test the vehicle for drive clutch drag or hard shifting while at idle speed. If shifting remains difficult, refer to “CLUTCH CENTER DISTANCE” to check positioning of the engine and transmission mounting.

CAUTION

Do not leave the vehicle unattended.

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CLUTCH OFFSET (EBS)

Clutch Offset Procedure

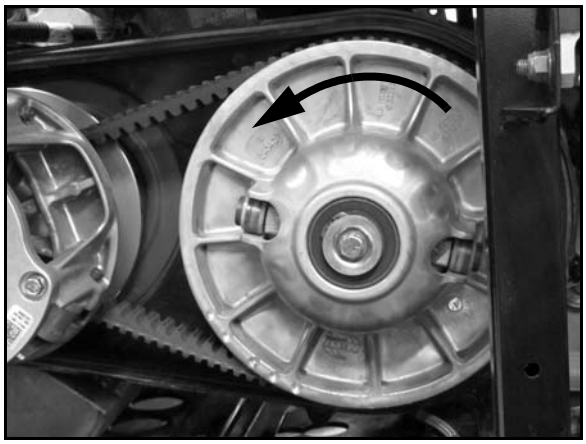
Clutch offset is controlled by the number of washers that are placed behind the driven clutch on the transmission input shaft. Adding washers behind the driven clutch will move the drive belt toward the moveable sheave. Removing washers will move the belt toward the stationary sheave.

If the vehicle exhibits drive clutch drag or hard shifting while at idle speed, a clutch offset adjustment is required.

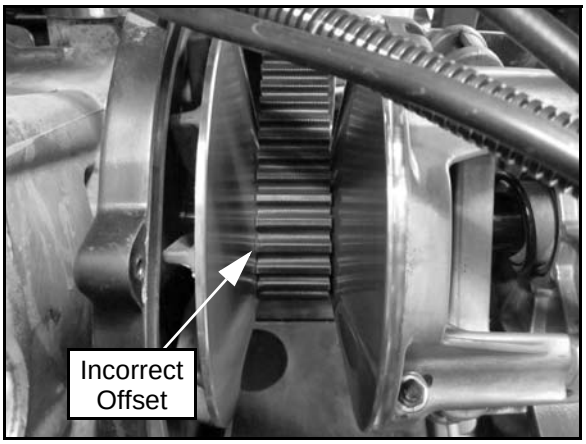
1. Remove the lower seat base.
2. Remove the LH storage container to gain access to the outer PVT cover.
3. Loosen the hose clamps and remove the PVT air outlet duct hose from the outer PVT cover.
4. Remove all outer PVT cover screws and cover.

> **CAUTION**
>
> Do not start the engine with the outer clutch cover removed. Serious injury may result.

5. Rotate driven clutch counterclockwise several times to ensure belt is tight and riding at the proper height.



6. Inspect drive clutch belt to sheave clearance. If belt is making contact with either sheave, remove drive belt and driven clutch. Refer to “DRIVE BELT (EBS) - Belt Removal”.



7. Add or remove offset washers behind the driven clutch accordingly to avoid belt contact with either drive clutch sheave.

Offset Washers:
(.030”) PN: 7556454
(.060”) PN: 7556120

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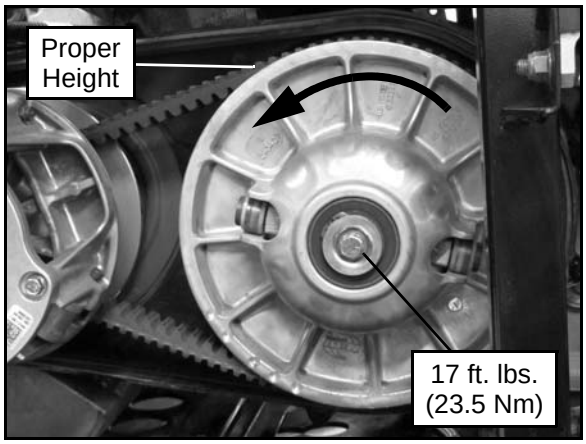
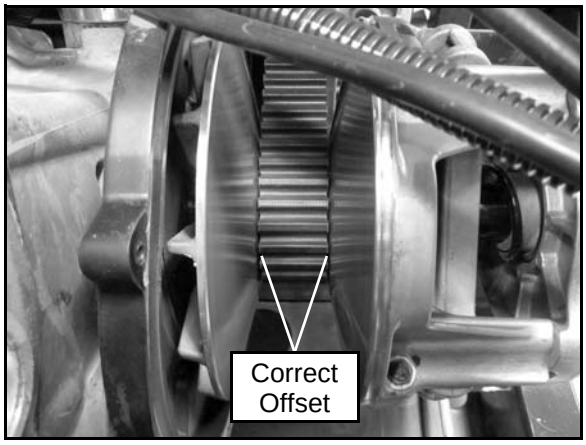
8. Reinstall the driven clutch and drive belt. Torque the driven clutch retaining bolt to **17 ft. lbs. (23.5 Nm)**. Be sure to rotate the driven clutch counterclockwise several times to ensure the belt is tight and riding at the proper height.



9. Inspect the belt to sheave clearance again. If the belt rests evenly between the drive clutch stationary and moveable sheaves, the offset is correct and the vehicle can be reassembled. If the belt is still contacting either sheave, repeat steps 6 - 9 until the correct offset is achieved.



10. Inspect the outer clutch cover gasket. Replace if damaged.

11. Install the outer clutch cover and (8) screws. Torque screws to specification.

= **T**
Outer Clutch Cover Retaining Screws: **45-50 in. lbs. (5.5 Nm)**

12. Position the PVT air outlet duct hose and tighten the hose clamps.

13. Install the LH storage container and lower seat base.

14. Sit in the driver's seat, apply the brake and start the engine. Place the gear selector in high range and test the vehicle for drive clutch drag or hard shifting while at idle speed. If shifting remains difficult, refer to "CLUTCH CENTER DISTANCE" to check positioning of the engine and transmission mounting.

CAUTION
Do not leave the vehicle unattended.

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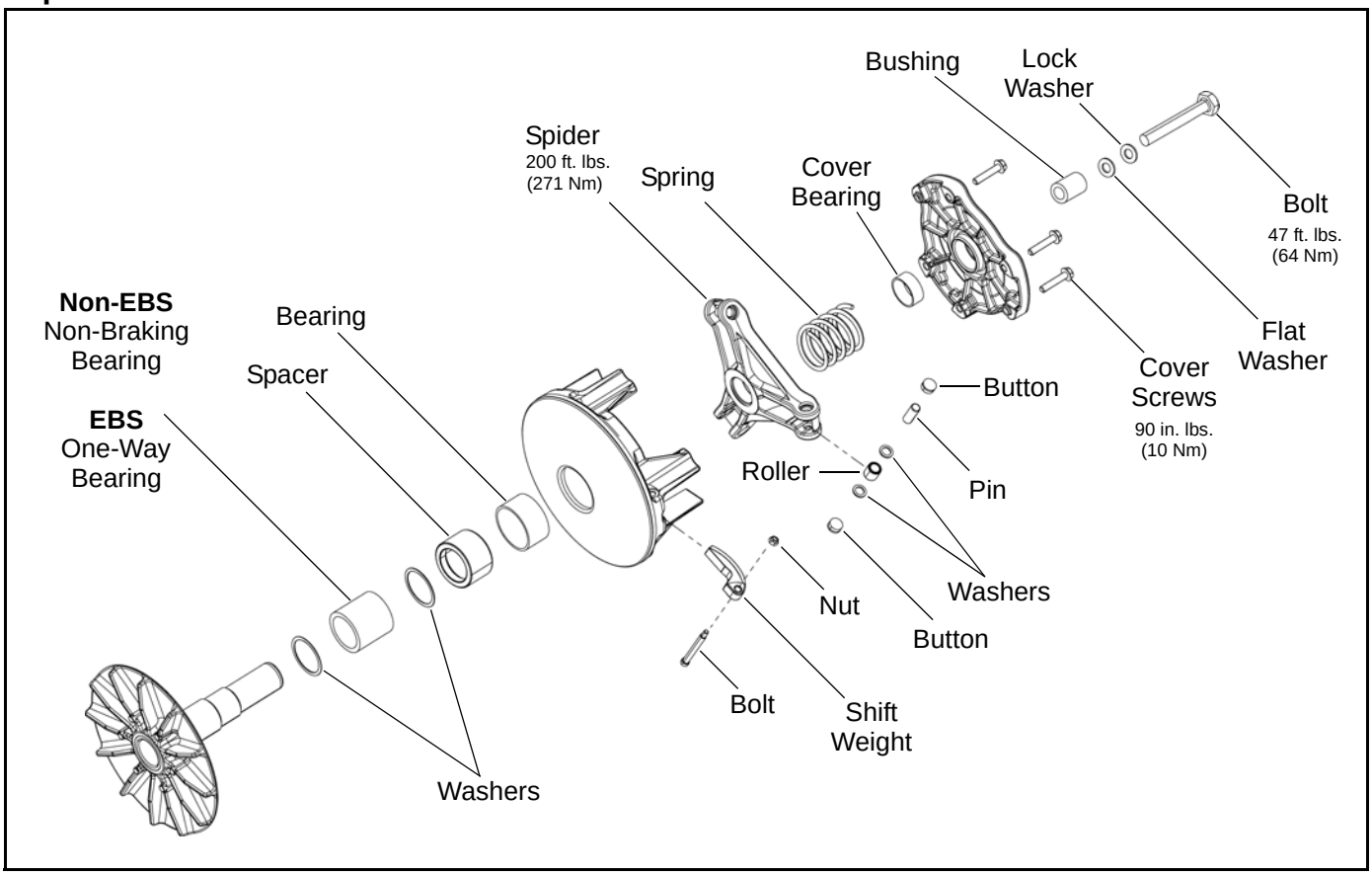
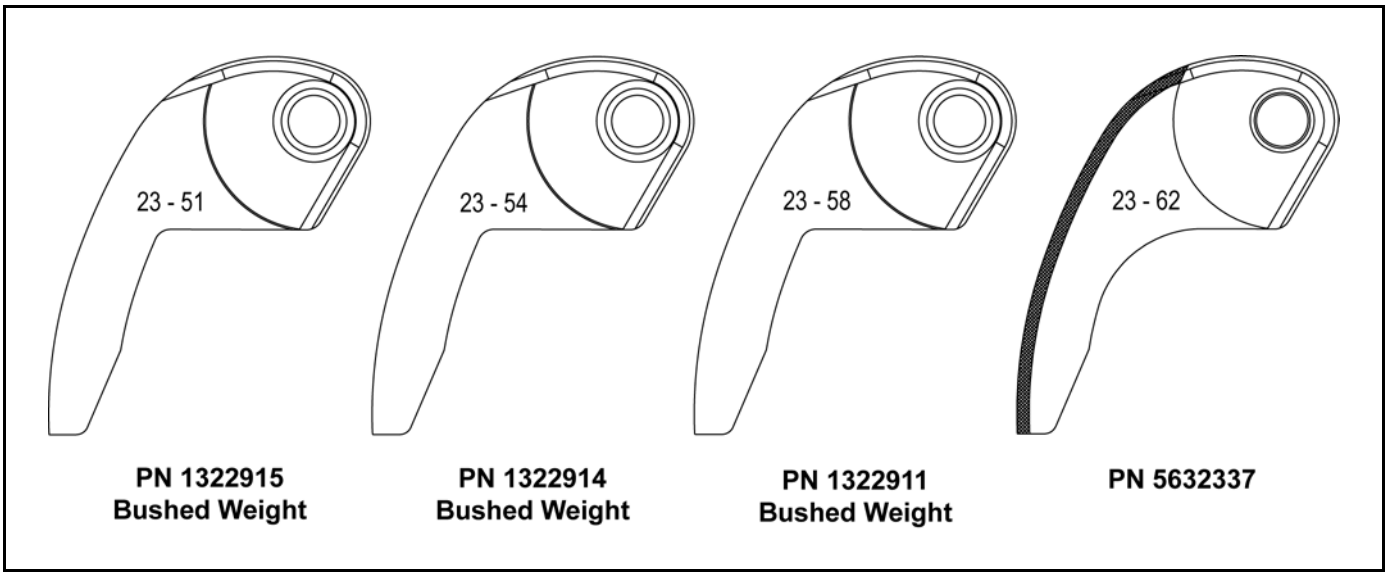
DRIVE CLUTCH SERVICE

Exploded View



Shift Weights

Shown below are the shift weights which have been designed for this PVT system. These shift weights have many factors designed into them for controlling engagement RPM and shifting patterns. Shift weights should not be changed or altered without first having a thorough understanding of their positioning and the effects they may have on belt to sheave clearance, clutch balance and shifting pattern.



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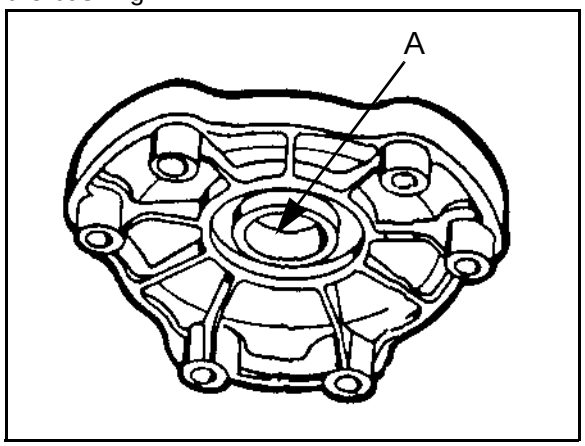
Clutch Disassembly

1. Using a permanent marker, mark the cover, spider, and moveable and stationary sheaves for reference, as the cast in X's may not have been in alignment before disassembly.

2. Mark the stationary sheave and clutch shaft to verify the shaft has not turned in the sheave after tightening the spider during clutch assembly.

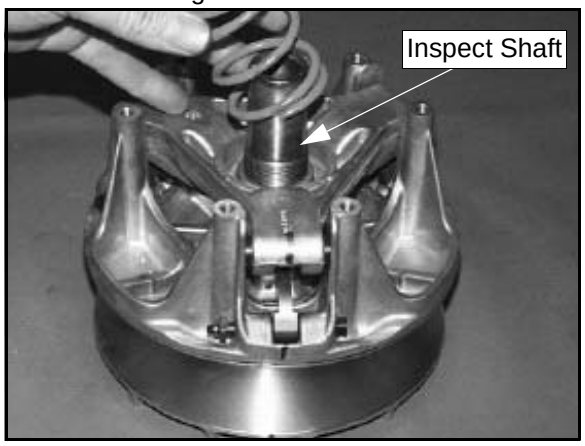
3. Remove cover bolts evenly in a cross pattern and remove cover plate.

4. Inspect cover bushing (A). The outer cover bushing is manufactured with a Teflon™ coating. Wear is determined by the amount of Teflon™ remaining on the bushing.



Cover Bushing Inspection: Replace the cover bushing if more brass than Teflon™ is visible on the bushing. Refer to bushing replacement in this chapter.

5. Inspect area on shaft where bushing rides for wear, galling, nicks, or scratches. Replace clutch assembly if worn or damaged.



6. Remove and inspect the clutch spring. See “Drive Clutch Spring Specifications” for spring inspection.

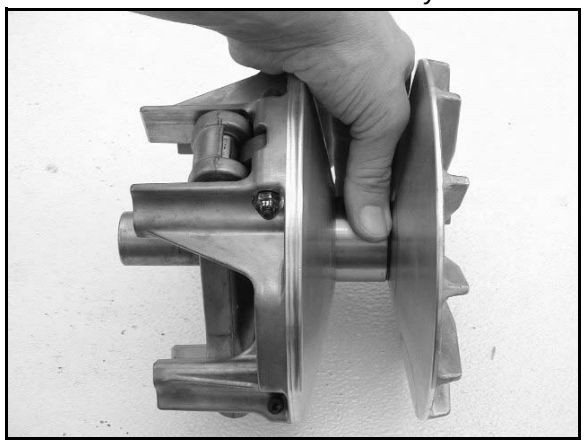
Bearing Inspection

1. Rotate the clutch bearing in both clockwise and counter-clockwise directions.

   - **Non-EBS:** The non-braking bearing should rotate both directions on the shaft with only a slight amount of drag.

   - **EBS:** The one-way bearing should rotate clockwise (when viewed from cover plate side) with only a slight amount of drag. When rotated counter-clockwise the one-way bearing should lock to the shaft without slipping.

2. Verify there is no binding or rough spots. If problems are noted continue with disassembly.



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Drive Clutch Spring Inspection

CAUTION

Never shim a drive clutch spring to increase its compression rate. This may result in complete stacking of the coils and subsequent clutch cover failure.

The drive clutch spring is one of the most critical components of the PVT system. It is also one of the easiest to service. Due to the severe relaxation the spring is subject to during operation, it should always be inspected for tolerance limits during any clutch operation diagnosis or repair.

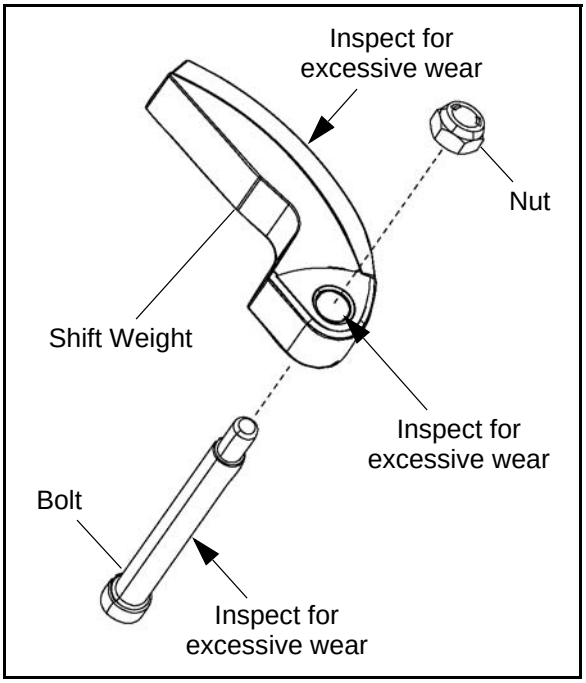
With the spring resting on a flat surface, measure its free length from the outer coil surfaces. Also check to see that spring coils are parallel to one another. Distortion of the spring indicates stress fatigue, requiring replacement.

Drive Clutch Spring Specifications

Part Number	7043594
Color	Black
Free Length	2.80 in. (7.11 cm)

Shift Weight Inspection

1. Remove shift weight bolts and weights. Inspect the contact surface of the weight. The surface should be smooth and free of dents or gall marks. Inspect the weight pivot bore and bolts for wear or galling. If weights or bolts are worn or broken, replace in sets of three with new bolts and nuts.



WARNING

The clutch assembly is a precisely balanced unit. Never replace parts with used parts from another clutch assembly!

NOTE: A damaged shift weight is usually caused by a damaged or stuck roller in the spider assembly. See “Roller, Pin and Thrust Washer Inspection”.

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Button To Tower Clearance Inspection

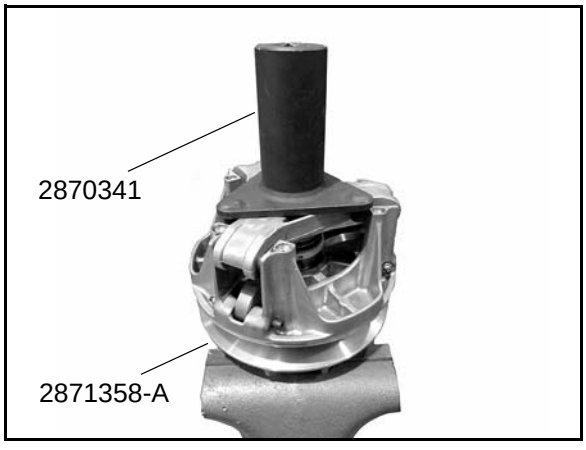
1. Inspect for any clearance between spider button to tower. If clearance exceeds specification, replace all buttons and inspect surface of towers. See “Spider Removal” procedure.

Button to Tower Clearance:
000-.005”

2. Inspect sheave surfaces. Replace the entire clutch if worn, damaged or cracked.

Spider Removal

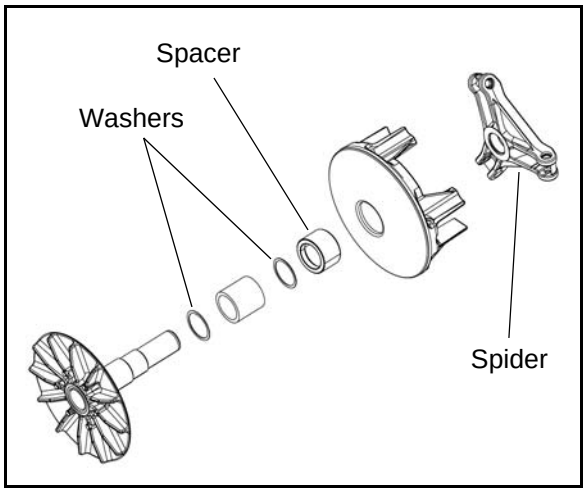
1. Install clutch in holding fixture (PN 2871358-A) and loosen the spider (counterclockwise) using Clutch Spider Removal Tool (PN 2870341).



Clutch Holding Fixture:
(PN 2871358-A)

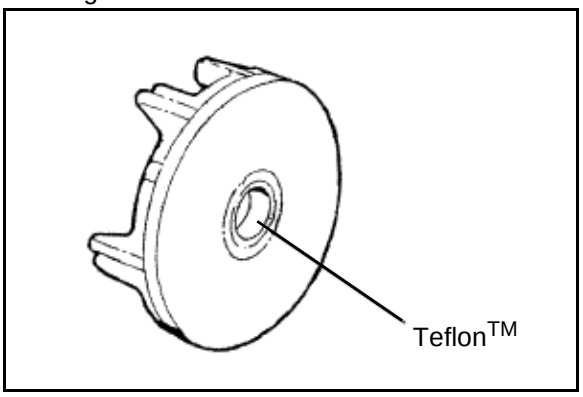
Spider Removal Tool:
(PN 2870341)

NOTE: To maintain proper clutch balance and belt-to-sheave clearance, be sure to reinstall the original quantity and thickness of washers/spacers beneath the spider during assembly.



Moveable Sheave Bushing Inspection

2. Inspect the Teflon™ coating on the moveable sheave bushing.



Moveable Sheave Bushing Inspection:

Replace the cover bushing if more brass than Teflon™ is visible on the bushing. Refer to “Bushing Service” in this chapter.

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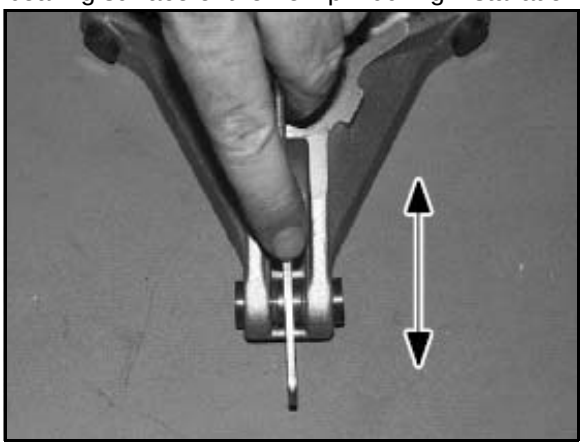
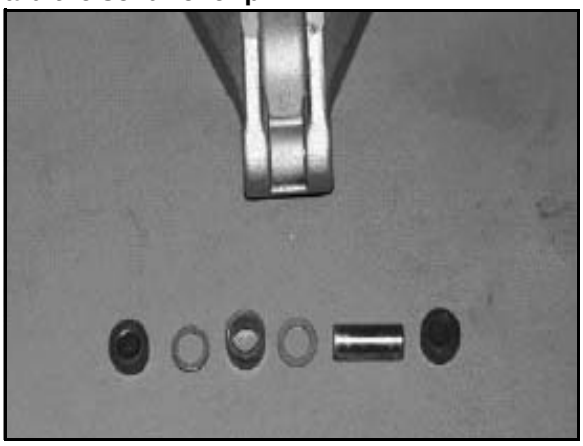
Roller, Pin, and Thrust Washer Inspection

1. Inspect all rollers, bushings and roller pins by pulling a flat metal rod across the roller. Turn roller with your finger. If you notice resistance, galling, or flat spots, replace rollers, pins and thrust washers in sets of three. Also inspect to see if roller and bushing are separating. Bushing must fit tightly in roller. Use the Roller Pin Tool (PN 2870910) to replace rollers and pins. Take care not to damage roller bushing or bearing surface of the new pin during installation.



2. Rubber backed buttons can be used in all *RANGER* clutches if the hollow roller pin is changed to the solid roller pin.

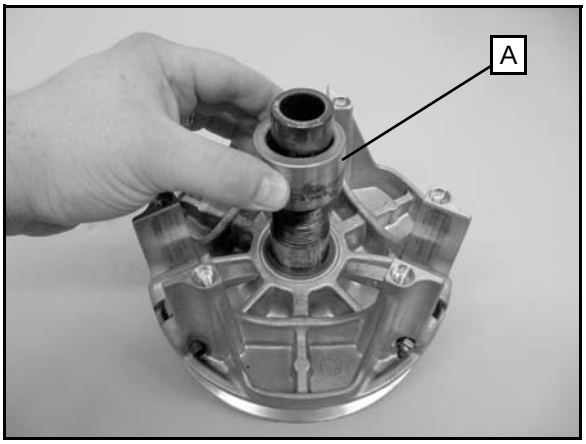
NOTE: The rubber side of the button is positioned toward the solid roller pin.



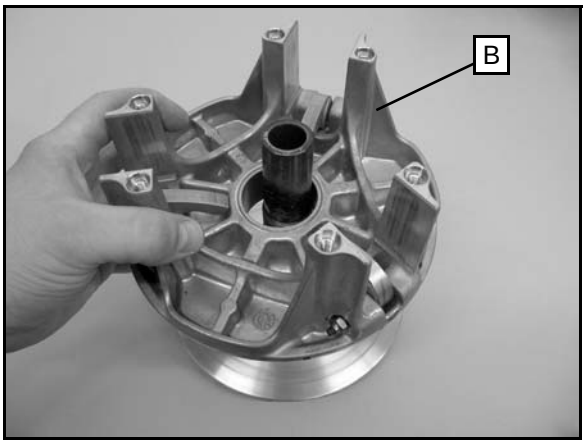
Clutch Inspection

NOTE: Remove cover, spring and spider following instructions for drive clutch disassembly, then proceed as follows:

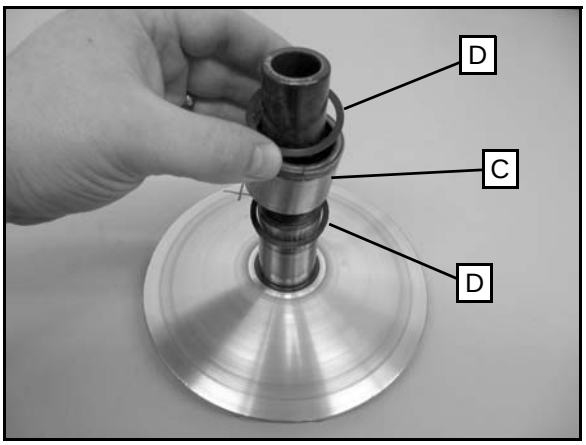
1. Remove the moveable sheave spacer (A). Inspect for damage or wear.



2. Remove the moveable clutch sheave (B). Inspect for damage or wear.



3. Lift bearing (C) and PTFE washers (D) off the shaft. Replace as an assembly if worn, damaged, or if problems were noted.



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4. Inspect surface of shaft for pitting, grooves, or damage. Measure the outside diameter and compare to specifications. Replace the drive clutch assembly if shaft is worn or damaged.

= In. / mm.
Shaft Diameter: **Standard: 1.3745” - 1.375” (34.91 - 34.93 mm)** **Service Limit: 1.3730” (34.87 mm)**

5. Visually inspect PTFE thrust washers for damage. Measure the thickness and compare to specification. Replace if worn or damaged.

= In. / mm.
PTFE Washer Thickness **Standard: .030” (.76 mm)** **Service Limit: .025” (.64 mm)**

Moveable Sheave Bushing Inspection

Inspect the Teflon™ coating (arrow) on the moveable sheave bushing. Inspect both sheaves for signs of wear, grooving or cracking. De-glaze sheave surfaces with a 3M™ Scotch-Brite Pad if needed.

Moveable Sheave Bushing Inspection: Replace the cover bushing if more brass than Teflon™ is visible on the bushing. Refer to “Bushing Service” in this chapter.

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Bushing Service

IMPORTANT: Special Tools Required

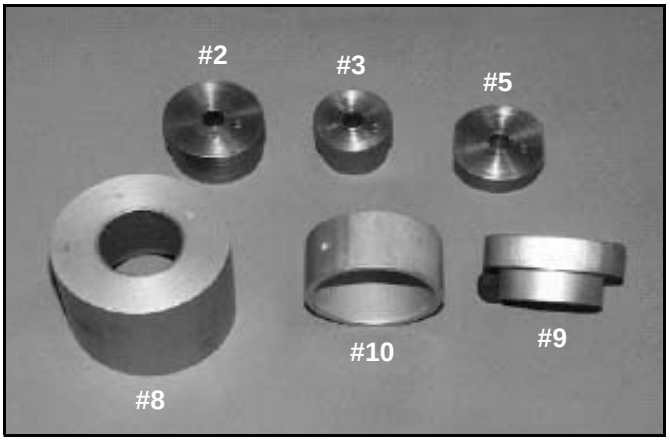
EBS Clutch Bushing Tool Kit - 2201379

Item	Qty.	Part Description	Part #
A, B	1	EBS Puller Tool	5132027
C	1	EBS Puller Nut	5132501
D	1	EBS Main Adapter	5132029
E	1	EBS Bushing Removal	5132028
--	1	Instructions	9915111

Additional Special Tools

Qty.	Part Description	Part #
1	Clutch Bushing Replacement Tool	2871226
1	Piston Pin Puller	2870386

***Clutch Bushing Replacement Tool Kit (PN 2871226**)



Item	Qty.	Part Description	Part #
#2	1	P-90 Drive/Driven Clutch Bushing Install Tool	5020628
#3	1	Drive Clutch Cover Bushing Removal / Installation Tool (all clutches)	5020629
#5	1	P-90 Driven Clutch Cover Bushing Removal Tool	5020631
#8	1	Main Puller Adapter	5020632
#9	1	Adapter Reducer	5010279
#10	1	Number Two Puller Adapter	5020633

NOTE: Bushings are installed at the factory using Loctite™. In order to remove bushings it will be necessary to apply heat evenly to the area around each bushing. Clean all residual Loctite™ from bushing bore prior to installing new bushing.

⚠ CAUTION

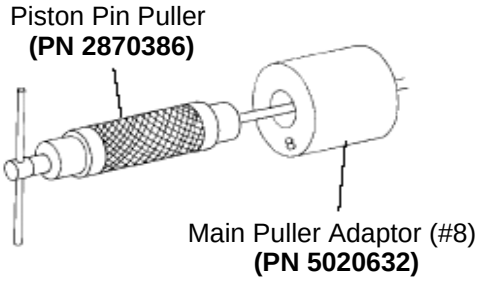
Clutch components will be hot! In order to avoid serious burns, wear insulated gloves during the removal process.

Moveable Sheave - Bushing Removal

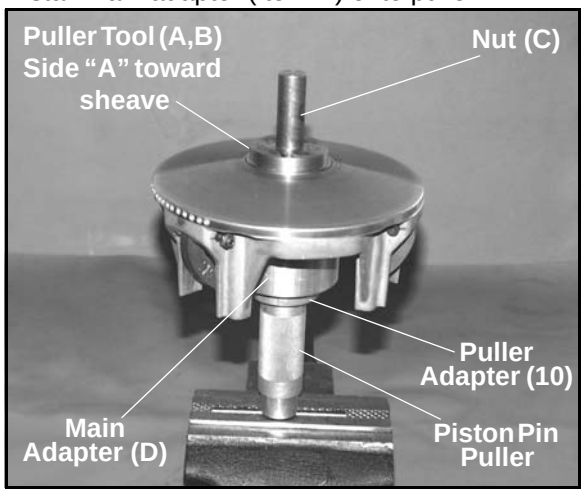
1. Remove clutch as outlined previously in this chapter.
2. Install handle end of the Piston Pin Puller **(PN 2870386)** securely into bench vise and lightly grease puller threads.

Piston Pin Puller (PN 2870386)

3. Remove nut from puller rod and set aside.



4. Install puller adapter (Item 10 from kit **PN 2871226**).
5. Install main adapter (Item D) onto puller.



6. With towers pointing toward the vise, slide sheave onto puller rod.
7. Install removal tool (Item A, B) into center of sheave with "A side" toward sheave.

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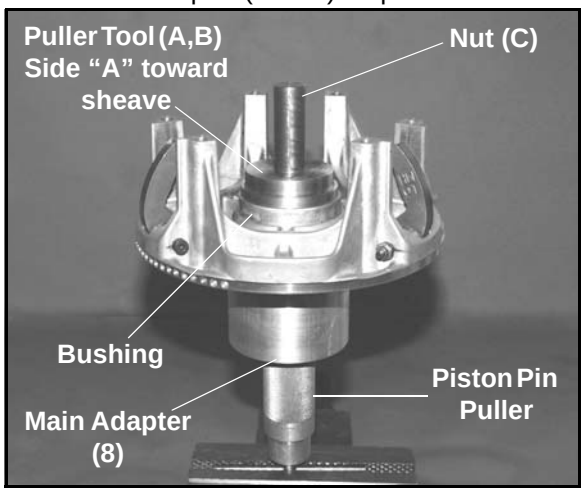
NOTE: Use Bushing Tool PA-47336.

8. Install nut (C) onto end of puller rod and hand tighten. Turn puller barrel to increase tension on sheave if needed. Using a hand held propane torch, apply heat around outside of bushing until tiny smoke tailings appear.
9. Turn sheave counterclockwise on puller rod until it comes free. Lift sheave off puller.
10. Remove nut from puller rod and set aside.
11. Pull bushing removal tool and adapter from puller rod. Remove bushing from tool and discard.

Drive Clutch Bushing Installation

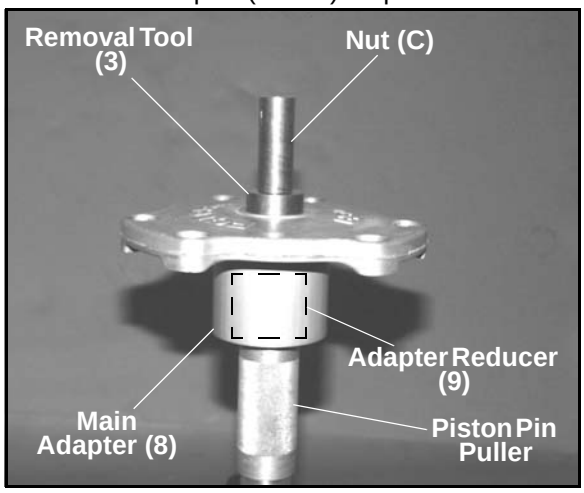
1. Place main adapter (Item 8) on puller.



2. Apply Loctite™ 609 evenly to bushing bore inside moveable sheave.
3. Set bushing in place on sheave.
4. Insert installation puller tool (Item A/B) with "A" side down, into center of bushing. **NOTE:** 800 EFI Clutch - Use **Bushing Tool PA-47336**.
5. With towers pointing upward, slide sheave, bushing and tool onto puller rod.
6. Install nut on puller rod and hand tighten. Turn barrel to apply additional tension if needed.
7. Turn sheave counterclockwise, making sure bushing is drawn straight into bore. Continue until bushing is seated.
8. Remove nut from puller rod and set aside.
9. Remove sheave from puller.
10. Remove installation tool.

Cover Bushing Removal

1. Install main adapter (Item 8) on puller.



2. Install adapter reducer (Item 9).
3. From outside of clutch cover, insert removal tool (Item 3) into cover bushing.
4. With inside of cover toward vise, slide cover onto puller.
5. Install nut onto puller rod and hand tighten. Turn puller barrel to increase tension as needed.
6. Turn clutch cover counterclockwise on puller rod until bushing is removed and cover comes free.
7. Remove nut from puller rod and set aside.
8. Remove bushing and bushing removal tool from puller. Discard bushing.

Cover Bushing Installation

1. Apply Loctite™ 609 evenly to bushing bore in cover.
2. Working from inside of cover, insert new bushing and bushing installation tool into center of clutch cover.
3. With main adapter on puller, insert cover onto puller rod, placing outside of cover toward vise.
4. Install nut on rod and hand tighten. Turn puller barrel to apply more tension if needed.
5. Turn clutch cover counterclockwise on puller rod until bushing is seated.
6. Remove nut from puller rod. Take installation tool and clutch cover off rod.

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Clutch Assembly

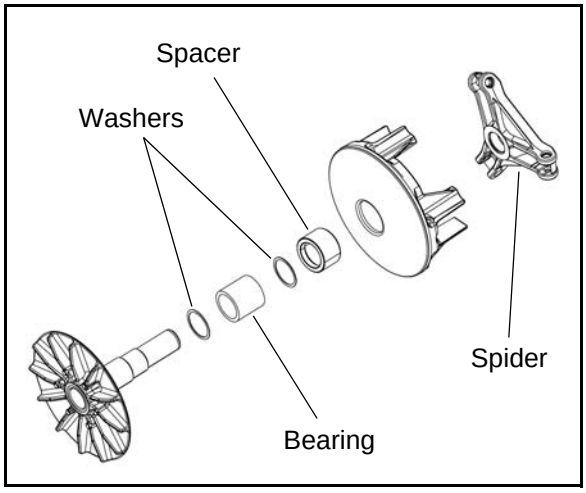
NOTE: The Teflon™ bushings are self-lubricating.

CAUTION
Do not apply oil or grease to the bushings.

Reassemble the drive clutch in the following sequence. Be sure the "X", or the marks that were made earlier are aligned during each phase of assembly.

1. Install the fiber washers and bearing over the clutch shaft. There should be one fiber washer on each side of the bearing.
2. Install the moveable sheave and spacer onto the clutch shaft.

NOTE: To maintain proper clutch balance and belt-to-sheave clearance, be sure to reinstall the original quantity and thickness of washers/spacers beneath the spider during assembly.



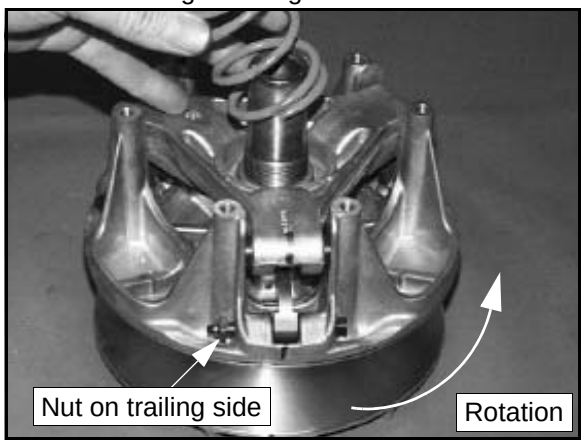
3. Compress spider buttons for each tower and install spider, making sure that "X" or the marks that were made earlier on the spider, aligns with "X" or the marks that were made earlier on the moveable sheave.
4. Torque spider to specification using the holding fixture and spider tool. Torque with smooth motion to avoid damage to the stationary sheave.

= T
Spider Torque: **200 ft. lbs. (271 Nm)**

5. After the spider has been torqued, remove the clutch assembly from the holding fixture and inspect the shaft and sheave alignment marks made during disassembly.

IMPORTANT: If the marks are no longer in alignment, the clutch will not be in balance and the drive clutch assembly must be replaced.

6. Install shift weights using new lock nuts on the bolts.



7. Reinstall clutch spring.
8. Reinstall cover, making sure that "X" or the marks that were made earlier the on spider, aligns with "X" or the marks that were made earlier on the cover.
9. Torque cover bolts evenly to specification.

= T
Cover Screw Torque: **90 in. lbs. (10.4 Nm)**

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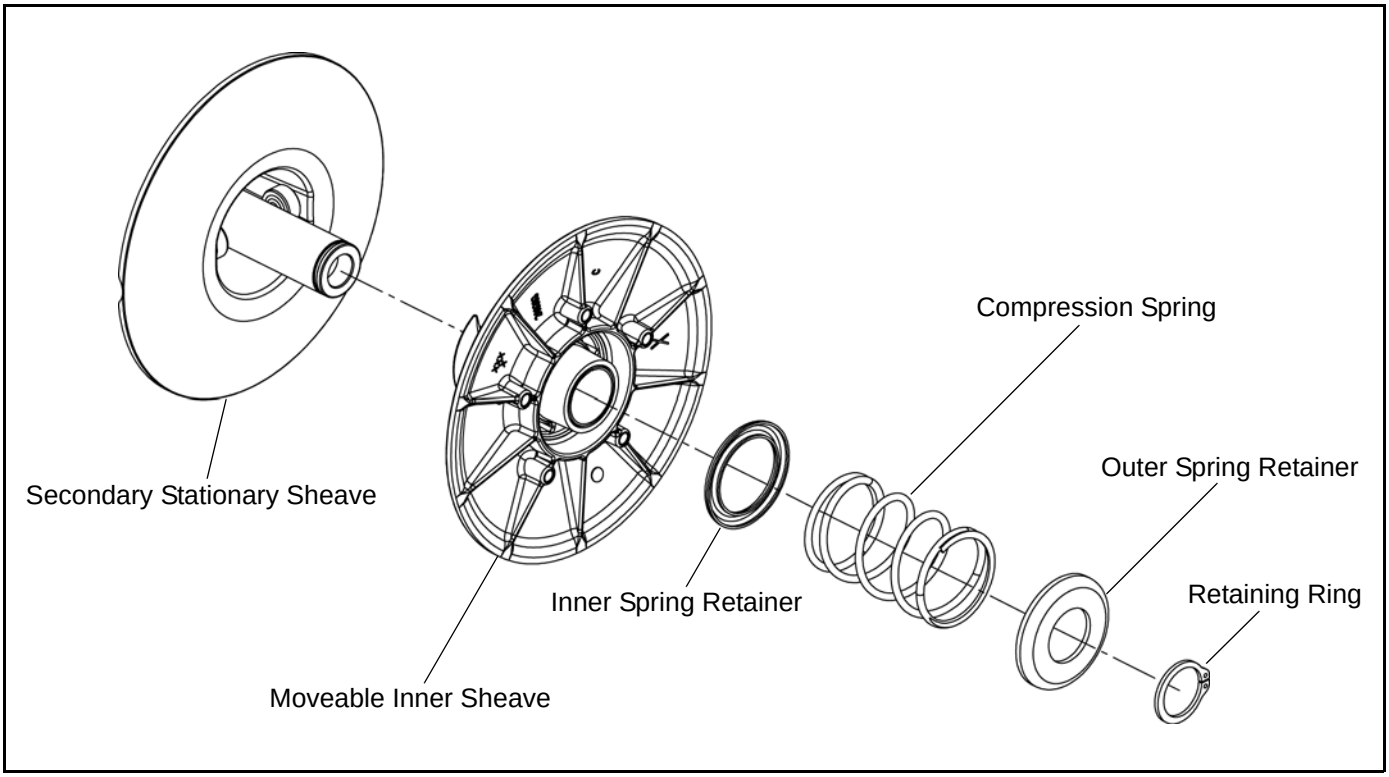
DRIVEN CLUTCH SERVICE (NON-EBS)

Exploded View

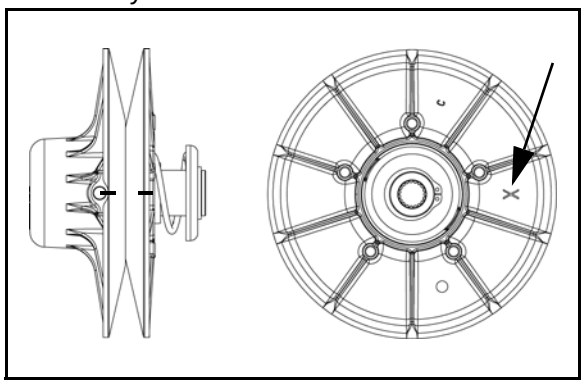


Clutch Disassembly / Inspection

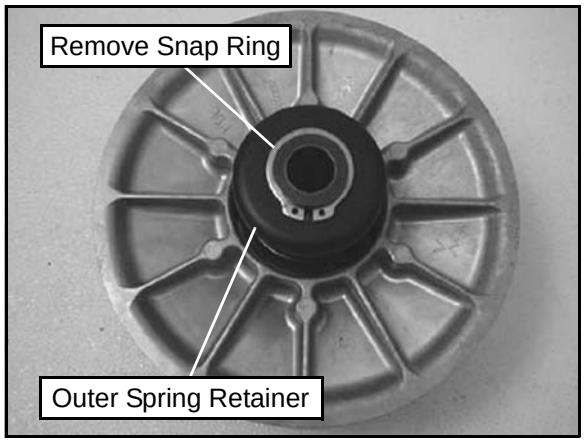
⚠ CAUTION

Wear eye protection when removing snap ring to prevent serious personal injury.
Use caution when removing, the snap ring pressure is loaded by the compression spring.

1. Remove driven clutch from transmission input shaft.
2. Mark position of clutch sheaves before disassembly or use the X's on the sheaves for reference. This aids in reassembly and maintains clutch balance after reassembly.



3. Place the driven clutch into the Universal Clutch Compressor **PU-50518.** Apply and hold downward pressure on the outer spring retainer. Carefully remove the snap ring. Remember the outer spring retainer contains strong spring pressure.



NOTE: Spring is compression only and has no torsional wind.

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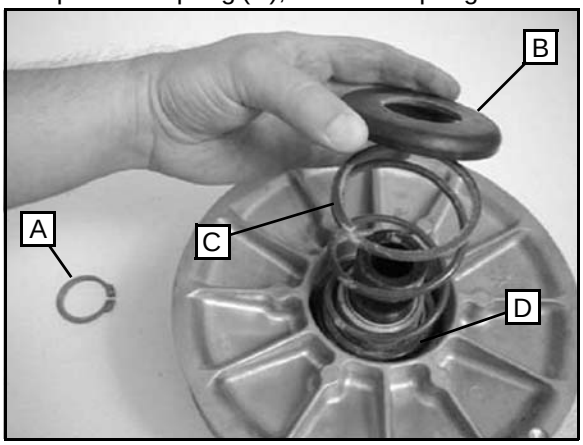
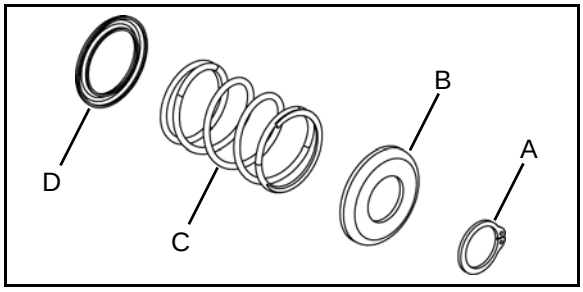
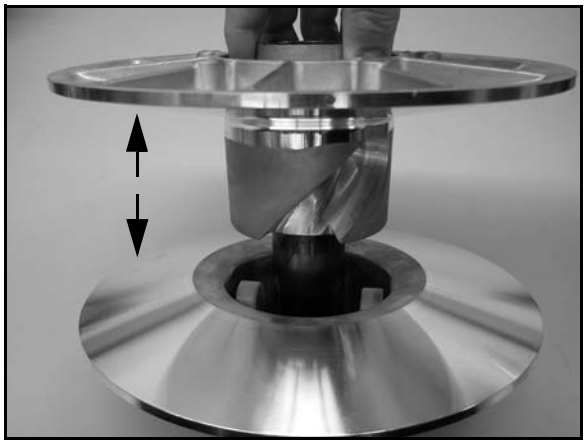
4. With the snap ring (A) removed and spring pressure relieved, remove the outer spring retainer (B), compression spring (C), and inner spring retainer (D).

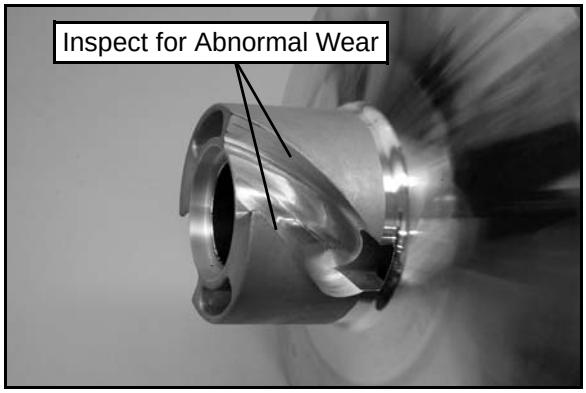




5. Separate the two clutch sheaves.

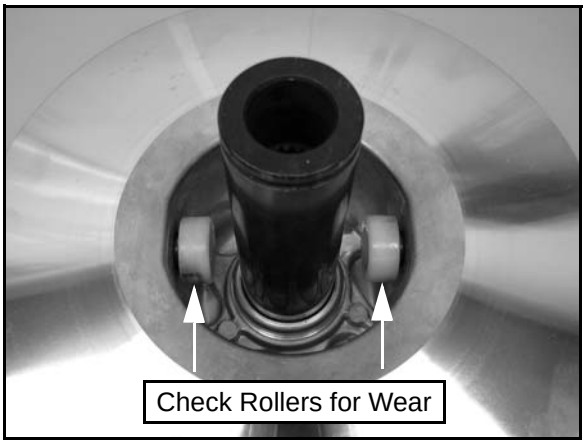


6. Inspect the helix on the moveable sheave.

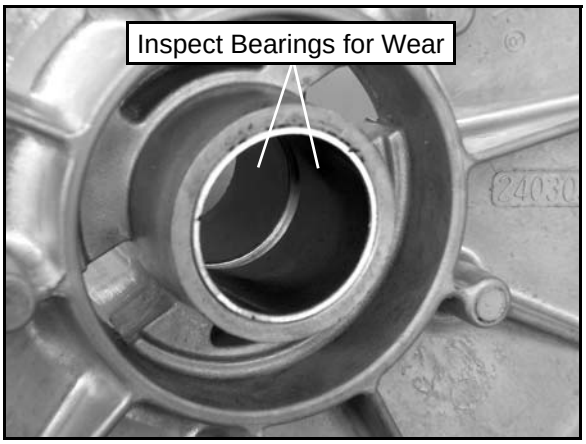


7. Inspect the inner spring retainer for wear and replace as needed.

8. Check the rollers in the stationary sheave for wear. If rollers are worn, a new driven clutch assembly may be needed.



9. Inspect the bearings inside the moveable sheave.



Moveable Sheave Bearing Inspection:
Replace the bearing if more brass than Teflon™ is visible on the bearing.

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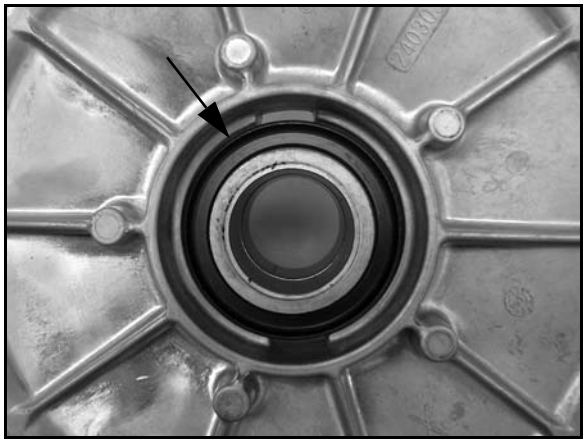
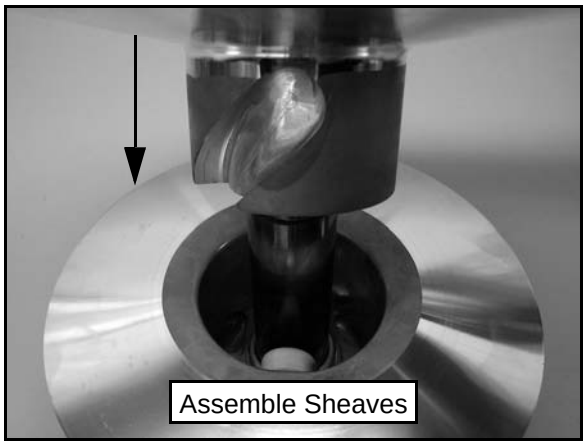
10. Inspect driven clutch sheave faces for wear or damage.
11. Clean and inspect splines on helix and transmission input shaft.
12. Lube splines with a light film of grease. **Do not lubricate the bearings!**

Clutch Assembly

1. Install the inner spring retainer if removed. **Do not apply oil or grease to the bearings.**

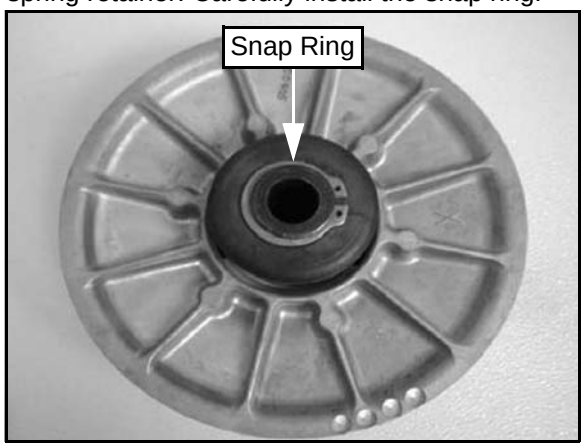


2. Align the “X” marks on each of the sheaves during reassembly.



3. Install spring into inner retainer.
4. Install outer retainer on top of spring.

5. Place the driven clutch into the Universal Clutch Compressor **PU-50518.**
6. Apply and hold downward pressure on the outer spring retainer. Carefully install the snap ring.



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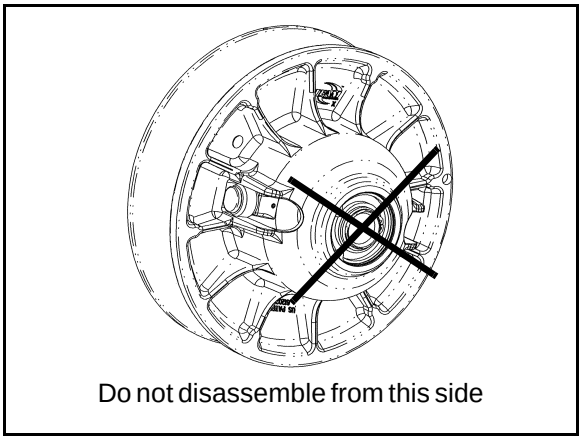
DRIVEN CLUTCH SERVICE (EBS)

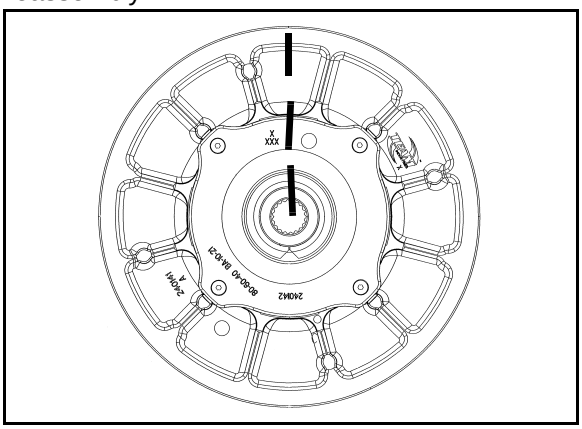
Clutch Disassembly

1. Remove driven clutch from the transmission input shaft. Do not attempt disassembly of the driven clutch from the outside snap ring. The driven clutch must be disassembled from the helix side.

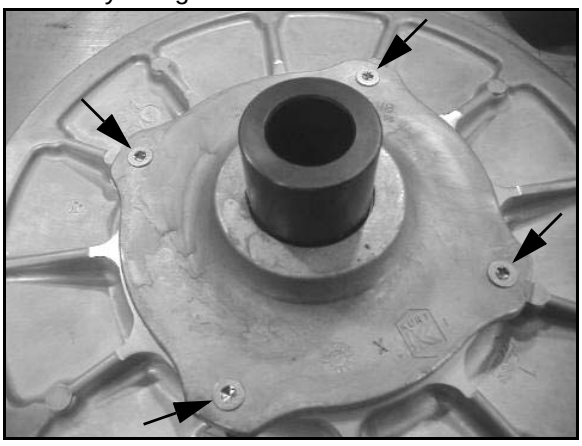


Do not disassemble from this side

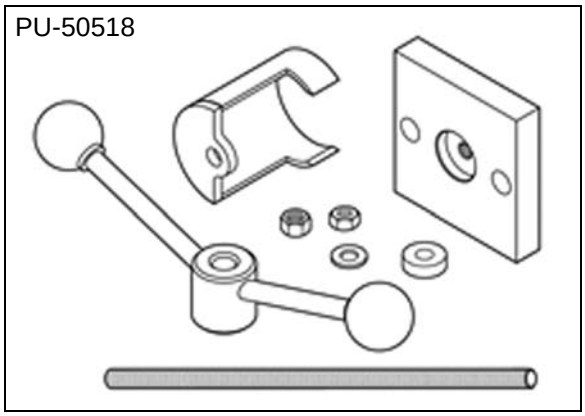
2. It is important to mark the position of the shaft, cam cover and sheave before disassembly or use the X's on the components for reference. This will aid in reassembly and helps to maintain clutch balance after reassembly.



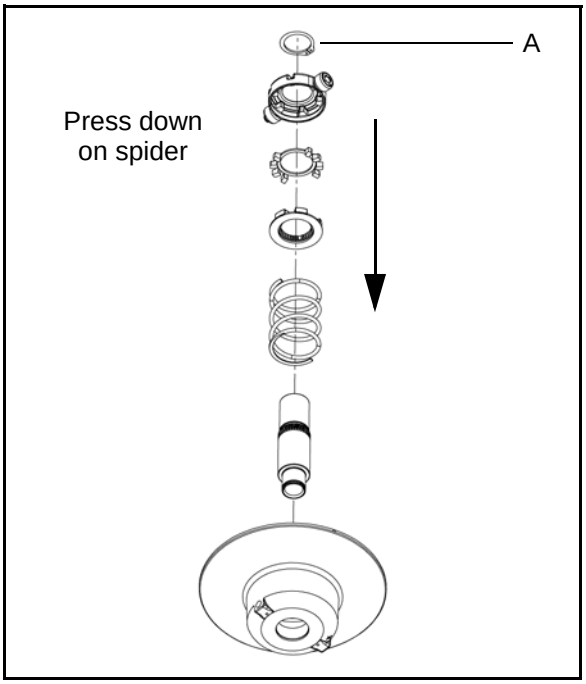
3. Remove the four screws that secure the cam (helix) assembly using a T25 Torx driver.



4. Place the driven clutch into the Universal Clutch Compressor **PU-50518**.



5. Press down on the top of the spider assembly, pushing the spider onto the shaft. Remove snap ring (A) and slowly release the assembly.



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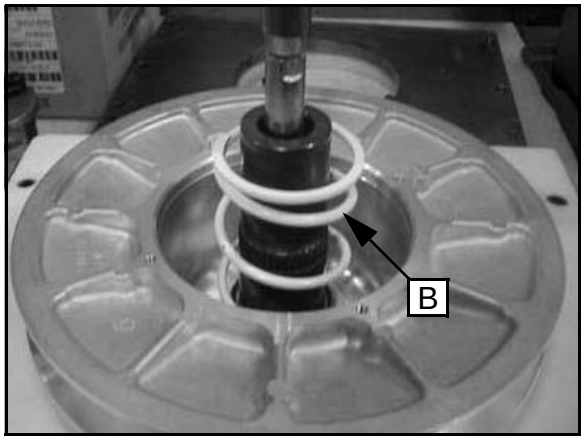
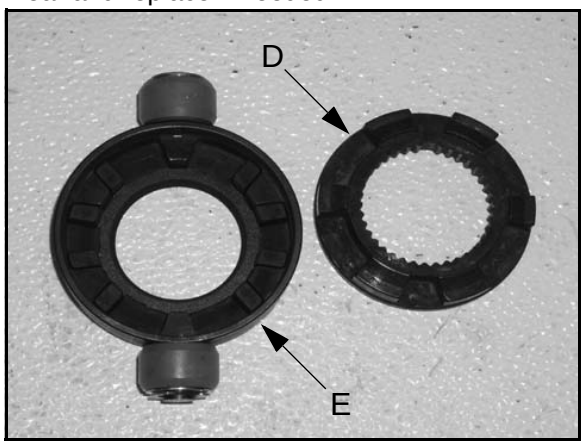
6. Remove the spider assembly and spring (B).

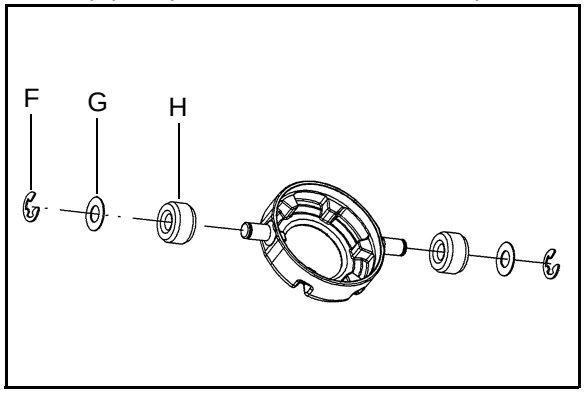
NOTE: Spring is compression only and has no torsional wind.



7. Remove the inside spider plate (D) and spider dampener (E). Inspect the spider dampener (E) for wear and replace if needed.

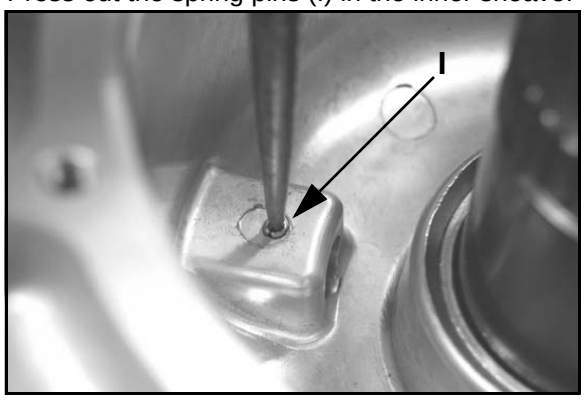


8. Remove the E-clips (F), washers (G), and the clutch rollers (H). Inspect the rollers for wear; replace if worn.

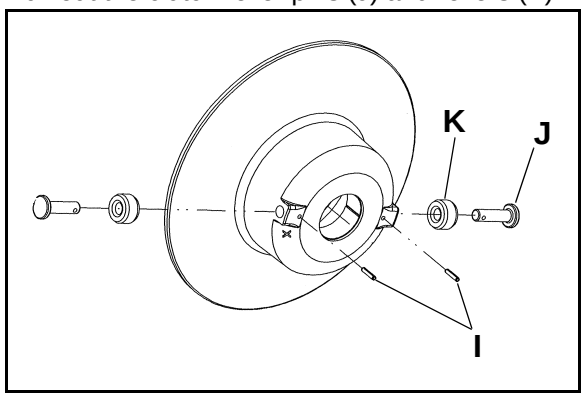


9. Remove the clutch assembly from the holding tool.

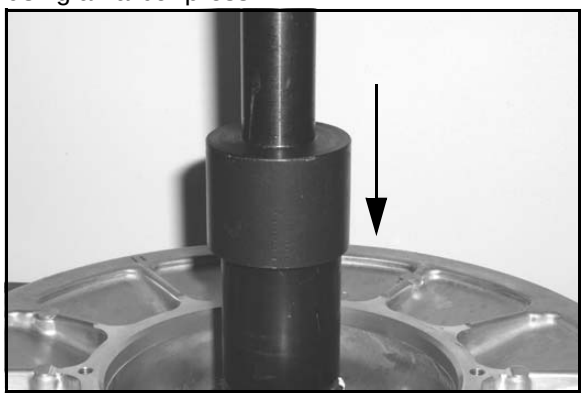
10. Press out the spring pins (I) in the inner sheave.



11. Pull out the clutch roller pins (J) and rollers (K).



12. Press the shaft and bearing out of the outer sheave using an arbor press.



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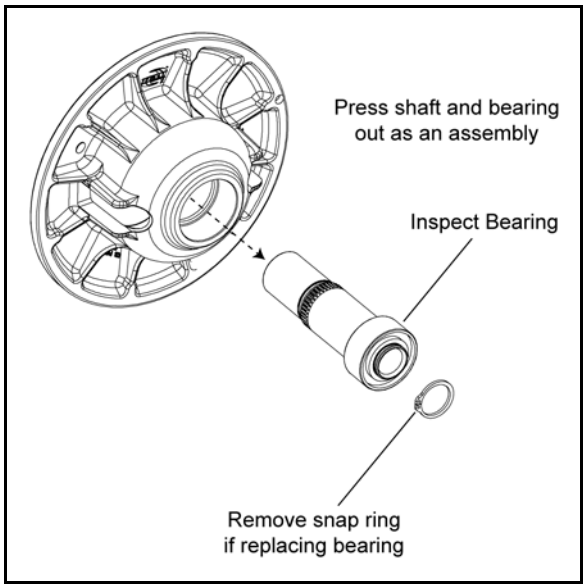
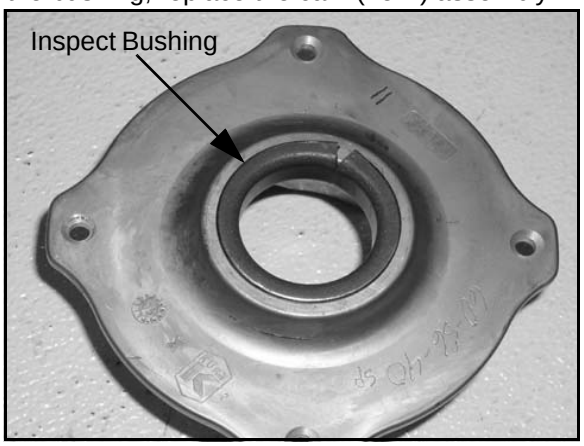
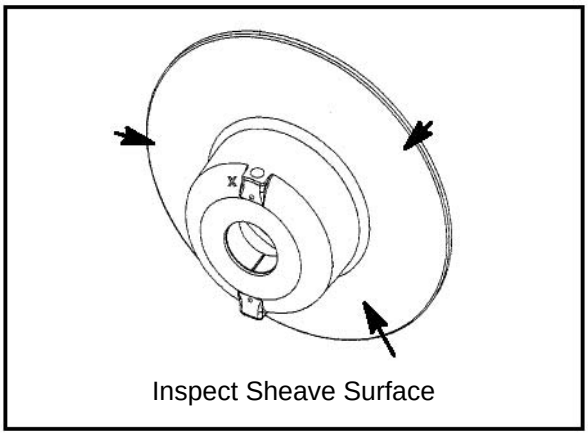
13. Inspect the bearing for wear. Spin the bearing, if the bearing does not spin smoothly, replace it. To replace the bearing, remove the snap ring from the end of the shaft and press the bearing off the shaft.



14. Inspect the cam (helix) assembly bushing for wear. If the bushing is worn or the shaft does not fit snug into the bushing, replace the cam (helix) assembly.



15. Inspect the clutch sheaves for excessive wear or damage.



Bushing Service

IMPORTANT: Special Tools Required

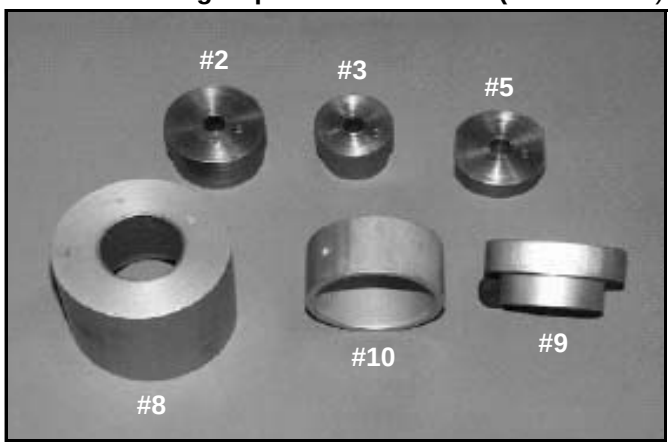
EBS Clutch Bushing Tool Kit - 2201379

Item	Qty.	Part Description	Part #
A, B	1	EBS Puller Tool	5132027
C	1	EBS Puller Nut	5132501
D	1	EBS Main Adapter	5132029
E	1	EBS Bushing Removal	5132028
--	1	Instructions	9915111

Additional Special Tools

Qty.	Part Description	Part #
1	Clutch Bushing Replacement Tool	2871226
1	Piston Pin Puller	2870386

***Clutch Bushing Replacement Tool Kit (PN 2871226)**



Item	Qty.	Part Description	Part #
#2	1	P-90 Drive/Driven Clutch Bushing Install Tool	5020628
#3	1	Drive Clutch Cover Bushing Removal / Installation Tool (all clutches)	5020629
#5	1	P-90 Driven Clutch Cover Bushing Removal Tool	5020631
#8	1	Main Puller Adapter	5020632
#9	1	Adapter Reducer	5010279
#10	1	Number Two Puller Adapter	5020633

NOTE: Bushings are installed at the factory using Loctite™ 609. In order to remove bushings it will be necessary to apply heat evenly to the area around each bushing. Clean all residual Loctite™ from bushing bore prior to installing new bushing.

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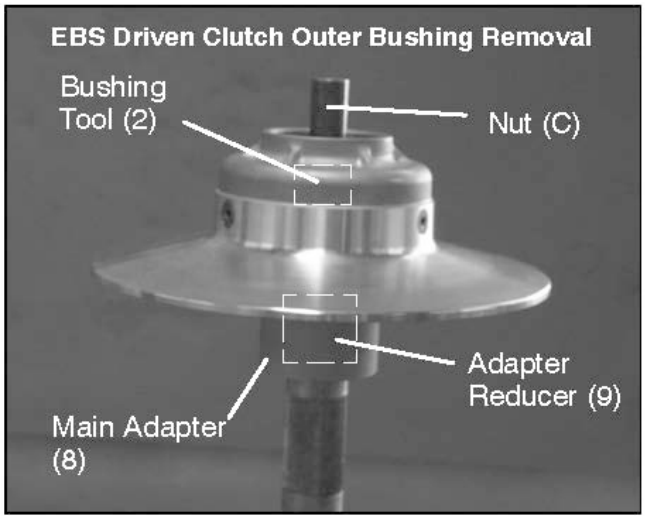
Clutch Bushing Removal

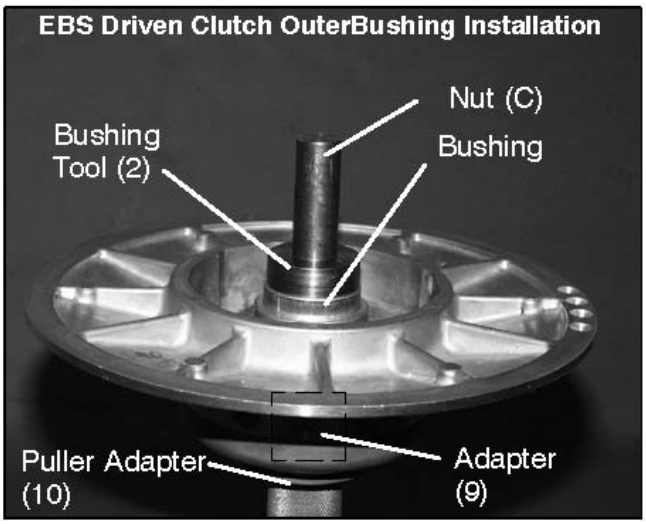
1. Install main puller adapter (Item 8) onto puller.
2. Install adapter reducer (Item 9).
3. Using a hand held propane torch, apply heat around outside of bushing until tiny smoke tailings appear.
4. Flip sheave over so bushing faces downward and install onto puller.
5. Install bushing tool (Item 2).



6. Install left hand nut (C) and spacer onto puller rod and tighten by hand. Turn puller barrel for further tension if needed.
7. Turn clutch sheave counterclockwise until bushing is removed and sheave comes free.
8. Remove nut (C) (left hand thread) from puller rod and set aside.
9. Remove adapters from puller.
10. Remove bushing and removal tool from adapters. Discard bushing.

Clutch Bushing Installation

1. Install puller adapter (Item 10) onto puller.
2. Install adapter (Item 9) onto puller.



3. Apply Loctite™ 609 evenly to bushing bore inside moveable sheave.
4. Install sheave face down on puller.
5. Install new bushing on installation tool (Item 2) and install assembly into sheave.
6. Install left hand thread nut (C) onto puller rod and hand tighten against installation tool.
7. Turn clutch sheave counterclockwise, making sure bushing is drawn straight into bore. Continue until bushing is seated.
8. Remove nut (C) from puller rod and set aside.
9. Remove installation tool and clutch sheave from puller.

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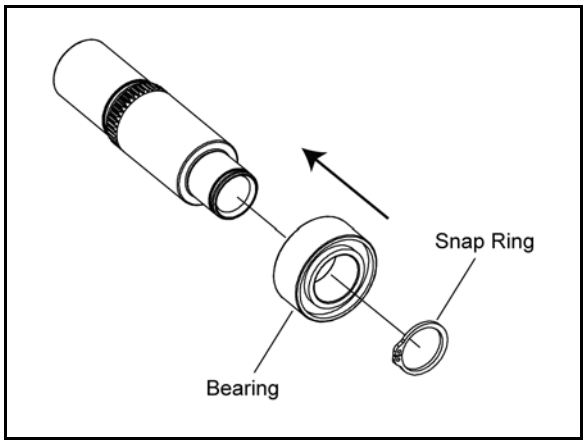
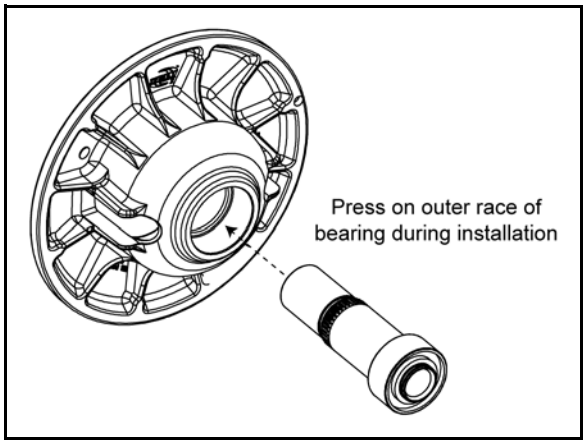
Clutch Assembly

1. Install a new bearing onto the clutch shaft using an arbor press. Once bearing is fully seated, install a new snap ring.

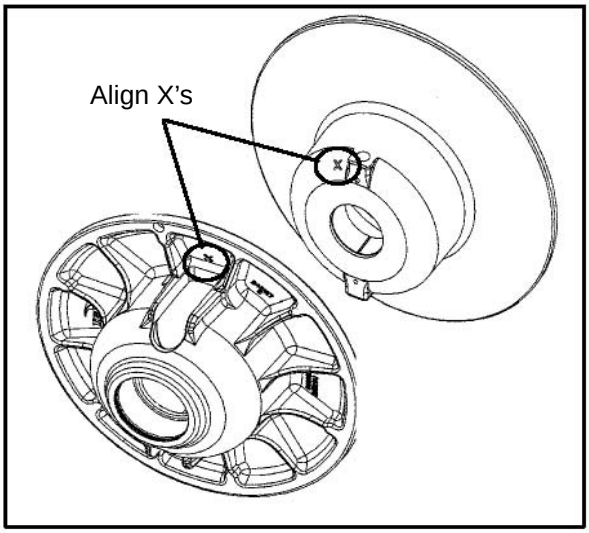


2. Install the shaft and bearing assembly into the outer sheave.

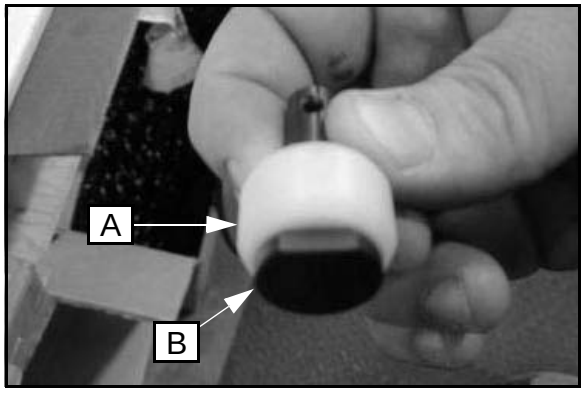


NOTE: Press only on the outer race of the bearing during installation to prevent damaging the bearing.

3. Line up the “X” on the moveable sheave with the “X” on the stationary sheave or use the marks previously used. Put the sheaves together.



4. Install the roller (A) onto the roller pin (B) on both sides.



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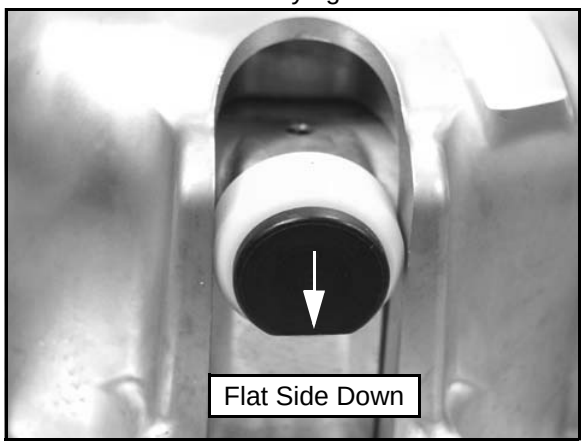
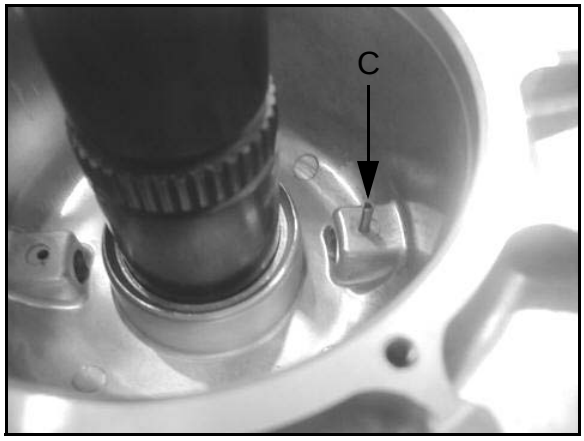
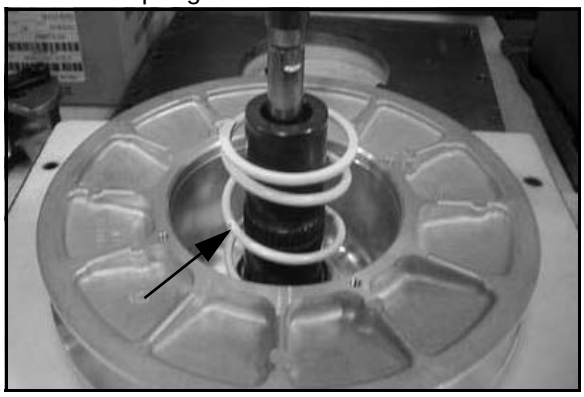
5. Install the roller pin into the sheave assembly on both sides. The flat side of the roller pin faces downward when the shaft side is laying flat on the bench.



6. Install the spring pins (C) to secure the roller pins. Install until flush with sheave surface.

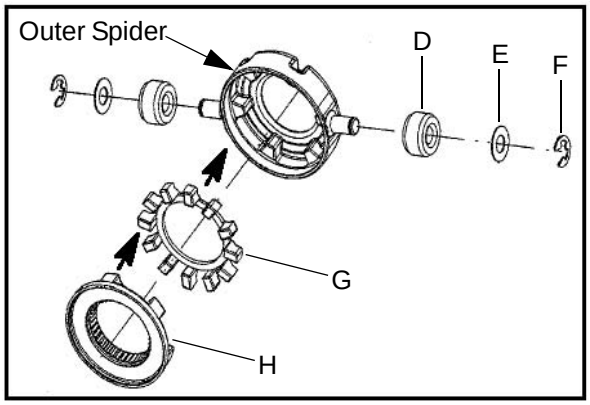


7. Install the spring over the shaft.

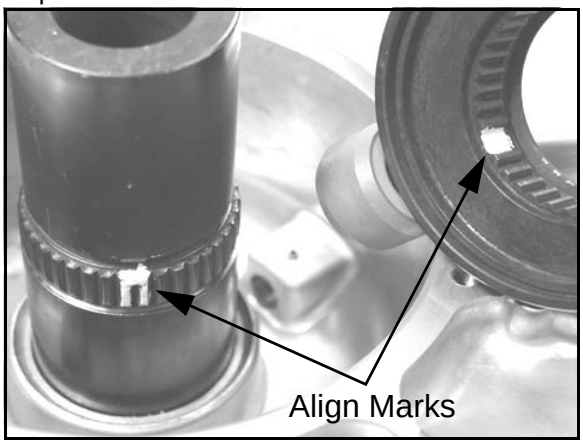


8. Install the clutch rollers (D) onto each side of the outside spider. Install the washers (E) and E-clips (F) to secure the rollers. The rollers should spin freely.

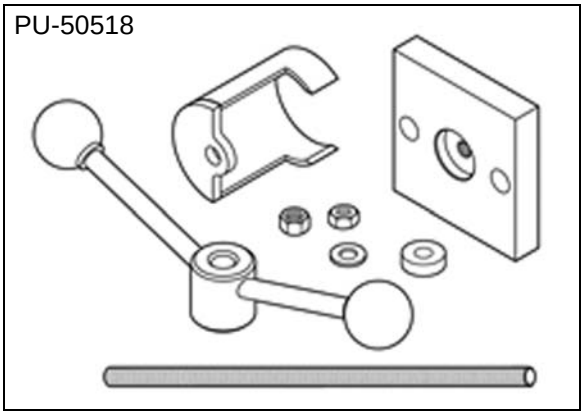
9. Install the spider dampener (G) inside the outer spider and install the inside spider plate (H).



10. Install the spider assembly onto the shaft with the retaining ring on top of the spider. **NOTE:** Use the marks previously made to align the skip tooth spider, or use the “X” on top of the spider and align it with the skip tooth on the shaft.



11. Place the driven clutch into the Universal Clutch Compressor **PU-50518**.



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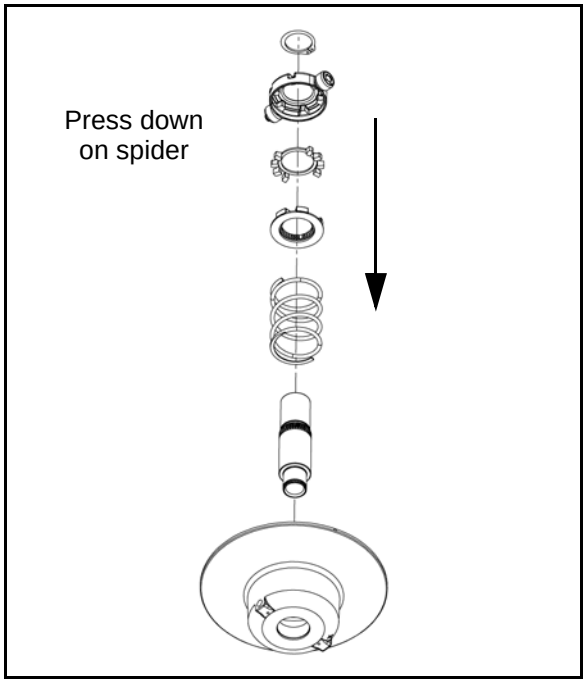
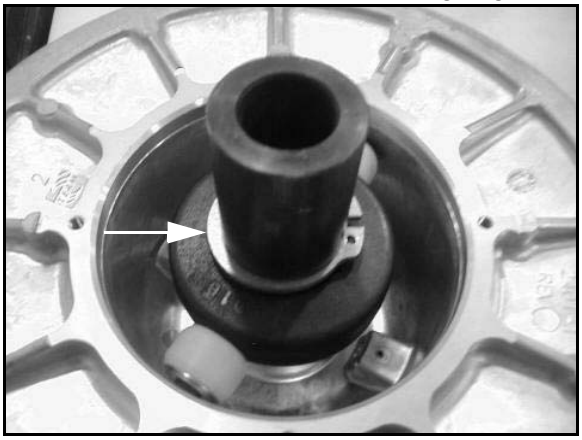
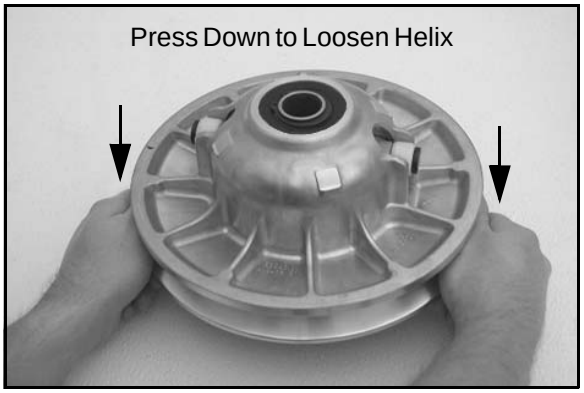
12. Press down on the top of the spider assembly, pushing the spider onto the shaft.



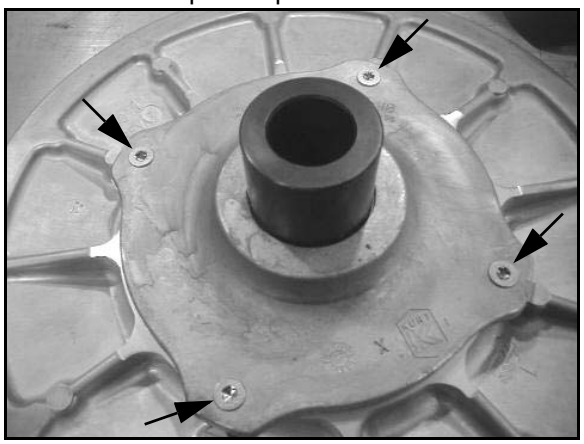
13. Slowly compress the spider into place. If the spider appears to bind while compressing, stop and make sure the skip-tooth on the shaft and the spider are aligned. Once the spider passes the retaining ring notch on the shaft, install the retaining ring.



14. Install the cam (helix) assembly over the shaft. Line up the “X” on the cam, “X” on spider, and “X” on the stationary sheave or use the marks previously made before disassembly. **NOTE:** If the cam assembly (helix) is difficult to install, be sure the sheaves are aligned. To align the sheaves place the clutch assembly on a flat surface with the cam assembly (helix) side down. Press down on the moveable sheave belt face with both hands and the helix will release.



15. Use a T25 Torx driver to install the four helix retaining screws and torque to specification.



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Helix Retaining Screws: **42-52 in. lbs. (4.75 - 5.88 Nm)**

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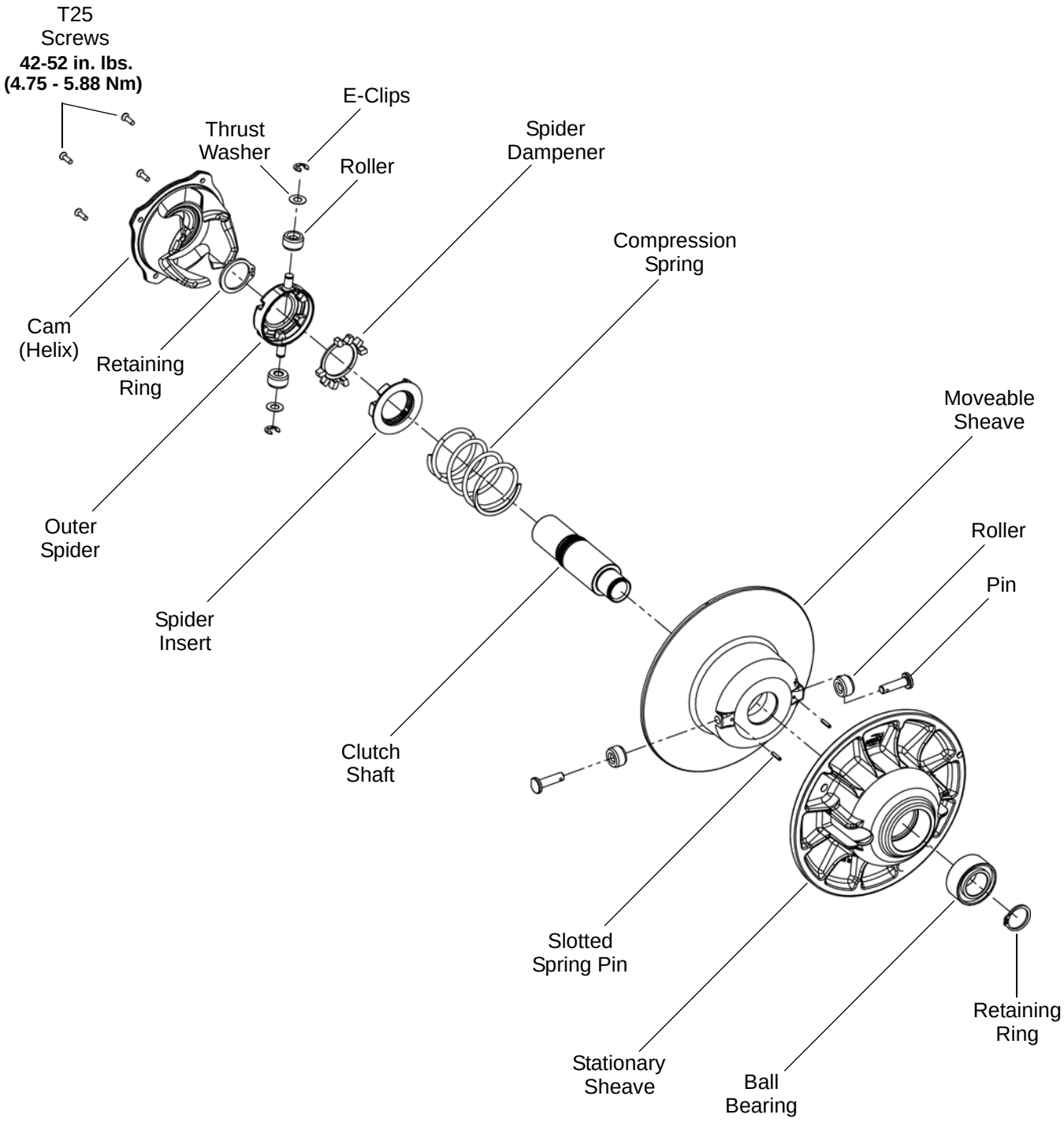
Exploded View



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TROUBLESHOOTING

Situation	Probable Cause	Remedy
Engine RPM below specified operating range, although engine is properly tuned.	-Wrong or broken drive clutch spring.	-Replace with recommended spring.
	-Drive clutch shift weight too heavy.	-Install correct shift weight kit to match engine application.
	-Driven clutch spring broken or installed in wrong helix location.	-Replace spring; refer to proper installation location.
Erratic engine operating RPM during acceleration or load variations.	-Drive clutch binding.	A. Disassemble drive clutch; inspect shift weights for wear and free operation. B. Clean and polish stationary shaft hub; reassemble clutch without spring to determine problem area.
	-Belt worn unevenly - thin / burnt spots.	Replace belt.
	-Driven clutch malfunction.	A. Replace ramp buttons. B. Inspect movable sheave for excessive bushing clearance.
	-Sheave face grooved.	-Replace the clutch.
Engine RPM above specified operating range.	-Incorrect drive clutch spring (too high of rate).	-Install correct recommended spring.
	-Drive clutch shift weights incorrect for application (too light).	-Install correct recommended shift weights.
	-Drive clutch binding.	-Disassemble and clean clutch, inspecting shift weights and rollers. Reassemble without the spring and move sheaves through entire range to further determine probable cause.
	-Driven clutch binding.	-Disassemble, clean, and inspect driven clutch, noting worn sheave bushing and ramp buttons and helix spring location.
	-Converter sheaves greasy; belt slipage.	-Clean sheaves with denatured alcohol or brake cleaner, install new belt.
Harsh drive clutch engagement.	-Drive belt worn too narrow.	-Replace belt.
	-Excessive belt / sheave clearance with new belt.	-Perform belt / sheave clearance adjustment with shim washers beneath spider.
Drive belt turns over	-Wrong belt for application.	-Replace with correct belt.
	-Clutch alignment out of spec.	-Adjust clutch alignment.
	-Engine mount broken or loose.	-Inspect / adjust or replace.
Belt burnt, thin spots	-Abuse (continued throttle application when vehicle is stationary, excess load)	-Caution operator to operate machine within guidelines.
	-Dragging brake	-Vehicle operated with park brake on. Inspect brake system.
	-Slow, easy clutch engagement	-Fast, effective use of throttle for efficient engagement.

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Troubleshooting, Continued.....

Situation	Probable Cause	Remedy
PVT cover overheating (melting)	-Plugged air intake or outlet.	-Clear obstruction
	-Belt slippage due to water, oil, grease, etc., rubbing on cover.	-Inspect system. Clean , repair or replace as necessary. Seal PVT system ducts.
	-Clutches or weight being applied to cover while in operation.	-Remove weight. Inform operator.
	-High vs. low range.	-Instruct operator on guidelines for operation in proper driving range for different terrain as outlined in Owner's Safety and Maintenance Manual.
Water ingestion	-Cover seals or ducts leaking	-Find leak and repair as necessary.
	-Operator error	-Instruct operator on guidelines for operation in wet terrain as outlined in Owner's Safety and Maintenance Manual.
Belt slippage	-Belt worn out	-Replace belt.
	-Water ingestion	-Inspect and seal PVT system.
	-Belt contaminated with oil or grease	-Inspect and clean.
PVT noise	-Belt worn or separated, thin spots, loose belt	-Replace belt.
	-Broken or worn clutch components, cover hitting clutches	-Inspect and repair as necessary.
Engagement erratic or stabby	-Thin spots on belt, worn belt	-Replace belt. Refer to belt burnt troubleshooting and instruct operator.
	-Drive clutch bushings stick	-Inspect and repair clutches.

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NOTES

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